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DEPARTMENT OF MINES.

GEOLOGICAL SURVEY OF NEW SOUTH WALES,
C. S. WILKINSON, F.G.S., F.L.S., GEOLOGICAL SURVEYOR IN CHARGE.

[illegible]

GEOLOGY

OF THE

VEGETABLE CREEK TIN-MINING FIELD,

NEW ENGLAND DISTRICT, NEW SOUTH WALES,

WITH

MAPS AND SECTIONS:

BY

T. W. EDGEWORTH DAVID, B.A., F.G.S.,
GEOLOGICAL SURVEYOR.

SYDNEY: CHARLES POTTER, GOVERNMENT PRINTER.
1887.

107892

Department of Mines, Geological Survey Branch,
27th July, 1886.

SIR,

I have the honor to submit the accompanying memoir on the Geology of the Vegetable Creek Tin-Mining District, New England, by Mr. T. W. Edgeworth David.

I have inspected the principal portions of the district with Mr. David.

The accurate and exhaustive description now given by him of its Geology and Mineral Resources will form a valuable work of reference, especially in connection with his Geological Map and Sections of this important Mining Field.

I have the honor to be,
Sir,
Your obedient Servant,
C. S. WILKINSON,
Geological Surveyor in Charge.

HARRIE WOOD, ESQ.,
Under Secretary for Mines.

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PART I.

DISCOVERY OF TIN AT VEGETABLE CREEK.

PREVIOUS to its discovery at Vegetable Creek, in 1872, tinstone is said to have been found at various places in Australia and Australasia. The probable occurrence of tin in Tasmania is mentioned by Mr. Bass, surgeon of H.M.S. "Reliance," in January, 1799, who found on the north coast of Tasmania, on the beach of Preservation Island, near the south coast of Barren Island, "a very considerable quantity of black metallic particles, which appear in the granite as black shining specks, and are in all probability grains of tin." A miner, named James Daw, claims to have discovered tin in 1849, on the Broadwater, a tributary of the Severn River, then in the Colony of New South Wales, now in Queensland. The first public mention of the occurrence of tin in New South Wales was made by the Rev. W. B. Clarke; in the *Sydney Morning Herald*, August 16th, 1849, he records having found it in the Alps, along part of the Murrumbidgee.

In 1851, Mr. E. H. Hargraves states that he has been shown metallic tin, smelted from tinstone, found by a shepherd on the Warranbungall mountains, which he describes as being 100 miles north-west of Cudgegong; Mr. Hargraves was unable to discover the tin in position. [*See* Mineral Products of New South Wales, 1882, page 101; account by Professor A. Liversidge.]

On the 11th of March, 1853, tinstone was first recognized in Victoria by Mr. George Foord, amongst the black sands brought from the gold-fields.

Tinstone was first found in the New England District, New South Wales, by the Rev. W. B. Clarke, who made an extensive examination of that part of New South Wales, and in his report, dated 7th May, 1853, drew attention for the first time to the occurrence there of extensive deposits of tin ore. He then stated that "Wolfram and oxide of tin with tourmaline occur near Dundee, and in Paradise Creek (a tributary of the Macintyre River, not the Paradise Creek of the Vegetable Creek District), and it is probable that this ore of tin is plentifully distributed in the alluvia of other tracts, as I have found it amidst the spinelle, rubies, oriental emeralds, sapphires, and other gems of the detritus from granite." [*See* Mines and Mineral Statistics of New South Wales, 1875, page 71; account by C. S. Wilkinson, Geological Surveyor.]

Little or no notice appears to have been taken of this important discovery of tin by Mr. Clarke in 1853.

In 1860, however, a considerable quantity of stream tin, obtained from the alluvials at Oban, in the same district, was purchased as such by Lassetter and Co.

In Victoria, upwards of 2,400 tons of ore were raised up to the end of the year 1864; and the following statistics* show the actual quantity of tin ore, black sand, and metalic tin exported from that colony up to the end of the year 1867.

TIN ORE.

	Tons.	Cwts.
Previously—up to the 31st December, 1866, black sand, and tin ore	2,473	4
From 1st January, to 31st December, 1867	177	10
Total	2,650	14

TIN.

	Lb.
Previously—up to 31st December, 1866	8,160
From 1st January, to 31st December, 1867	4,256
Total	12,416

In the beginning of the year 1872 public interest in New South Wales was aroused by the accidental discovery of tinstone, by the Messrs. Fearby, at Elsmore, near Inverell. Mr. Cleghorn, of Uralla, had sent the Messrs. Fearby to prospect the creeks of this district for gem-stones, the best localities for which were pointed out to them by an old shepherd on Newstead Station, named Wells. Mixed with a number of sapphires and other gems, in the gravels of the creeks, was a heavy black mineral, in water-worn grains, which the Messrs. Fearby, supposing to be tinstone, sent to Sydney to be assayed for tin. The result of the assay proved that this black mineral was oxide of tin, and the discovery becoming known, Baron and Moxham and other capitalists took up the ground near the present Elsmore mine. Then commenced the rush to the New England tin-fields. The stream tin under the title of "black sand" had been long familiar to gold-miners in New England, at Oban and elsewhere, where its weight, rendering it difficult of removal from the sluice-boxes, had caused it to be regarded as worse than a nuisance; and at Captain Swinton's station, near Tingha, I was informed that his stockmen were in the habit of using the stream tin of Cope's Creek for cleaning their bits.

---

* Gold-fields and Mineral Districts of Victoria, by R. Brough Smyth, Melbourne, 1869.

As knowledge of its value spread, eager prospecting led to its presence being proved over wide areas,—areas which have been constantly extended since this discovery of tin at Elsmore, in 1872, until the latest finding of tin at Gumble, near Molong, in 1885.

The stanniferous area of this Colony has now an extent of about 8,700 square miles, and the total quantity of tin produced in the Colony from the first opening of the tin-fields, in 1872, until the end of 1885, was 75,768 tons 0½ cwt. of ingot tin, valued at £6,145,799, and 16,153 tons 2 cwts. of tin ore, valued at £789,004, the total value of ingot tin and ore exported being £6,934,803.

Vegetable Creek is only 34 miles distant, in a direct line north-north-east from Elsmore, so that at the time when prospecting for tin was being so vigorously prosecuted in its neighbourhood, it was impossible for such a rich stanniferous area to remain long unknown; and in March, 1872, Thomas Carlean first discovered stream tin here, near the source of Vegetable Creek.

PART II.

HISTORY OF TIN-MINING AT VEGETABLE CREEK.

The spot where stream tin was first worked here is now held by the Great Britain Company, and forms part of the Strathbogie Run, of which Mr. Hugh Gordon, of Strathbogie, is the lessee. The township of Emmaville, 1 mile westerly from this spot, stands near the head of a shallow valley at an elevation of about 2,960 feet above the sea. The greater part of this valley is now covered with mounds of gravel and rubble, and the surface of the ground has been literally cut to pieces by numerous excavations, quarries, trenches, tunnels, and shafts. The original natural features of the creek and its surroundings here have, in consequence, become obliterated; but the appearance which it presented to the original prospectors may be gathered from the account of it, furnished by Mr. Hamilton Gordon, who described it as a swampy flat, about 2 miles in extent, with a few waterholes at its lower end. Here the first miners started washing the sands and gravels for stream tin. Of their early work no record is preserved in the annals of the Department, beyond the fact that 2,345 tons of tin ore were won from the shallow gravels, and 247 tons from the "deep leads," up to the end of 1873. From that date until the present a connected history of tin-mining in this district may be read in the yearly reports of the Mining Registrars, published in the Annual Reports of the Department.

1874.—The Mining Registrar, Mr. G. H. Gower, in his excellent Report for 1874,* describes the stream works as being located on the course of the Vegetable Creek, from its source downwards for 3½ miles. This ground was divided into ten holdings, all of which were worked by European miners, chiefly on the wages system, most of the ground having now passed into the hands of companies. The old system, imported from the gold-fields, of washing the tin gravel with the narrow box and sluice-fork had already been superseded by the cheaper method of the hopper-plate and large sluice-box, and the square-mouthed shovel had been substituted for the fork.

---

* Mines and Mineral Statistics of New South Wales, 1875, pages 63–70.

In places the stanniferous gravel and rubble was found to be cemented so firmly that it required to be broken up by puddling before it could be passed through the sluice-box. This necessitated the introduction of horse-power, which was also applied successfully, by Mr. W. H. Wesley, the manager of the Great Britain Tin-mining Company, to an ingenious apparatus, of his own contrivance, for washing the puddled tin gravel. The need for saving water was increased at this time by what was then considered a prolonged drought. The miners, however, had not yet learned that the rainfall of the district was so unevenly distributed over the months of the year that it was necessary to store the storm-water in dams and tanks, in order to secure a supply sufficient for mining purposes.

While the ten companies above mentioned were employed in working the gravel and "cement" on the swamps of Vegetable Creek, another company—the Vegetable Creek Tin-mining Company—were following what they considered to be a branch deposit of stream tin gravel, $\frac{1}{4}$ mile south of the main workings. This was destined to lead to the very important discovery of the "deep leads." In the Tingha district, Mr. C. S. Wilkinson, F.G.S., F.L.S., &c., as early as 1872, in his Report to the Surveyor-General, had drawn attention to the importance of the then undiscovered "deep leads" in that district, and their subsequent development there was due directly to his advice. In the Vegetable Creek district their discovery was made at three points almost simultaneously—accidentally at two of these three points. Mr. Thomas Reynolds claims to have been the first to have discovered surface "deep lead" stream tin in the volcanic soil at the head of what was afterwards known as the "Rose Valley Lead," 1873. It must be stated, however, that at this time the Vegetable Creek Tin-mining Company were actually working on "deep lead" stream tin, without being aware of its precise nature; and at Kangaroo Flat, at the lower end of the "deep lead," Hall Brothers were working stream tin under a basalt formation, at from 20 to 70 feet from the surface.

Two features in connection with tin-mining, during 1874, are worthy of being recorded. Messrs. Moffat & Harridge, of Stanthorpe, were engaged in erecting tin smelting works at Tent Hill, 4 miles easterly from Emmaville, and tin lode mining was commenced on the Mole Tableland, and the first tin-crushing machinery in the Colony erected at the Battery Mountain, at the source of the Nine-mile Creek, Wellington Vale, by the Planet Tin-mining Company.

1875.—While the ten shallow mines, already mentioned, on the course of Vegetable Creek, continued to yield tin steadily, the Vegetable Creek Tin-mining Company, while following their branch lead, came upon a deposit of stream tin of immense richness. When working this lead they found it gradually led them into deeper ground, so that they could no longer remove the "overburden" by "stripping," but raised the payable tin gravel by means of a tunnel 2,000 feet long. As the made ground deepened a thick layer of hard blue metal came in, forming a natural casing over the underlying clay, and tin gravels. The same thing was experienced in tracing the Rose Valley lead down from its source. The stream tin gravels dipped gradually under a blue rock, similar to that at the Vegetable Creek Tin-mining Company's mine, but more decomposed.

The ore produced by the Vegetable Creek Tin Mining Company's mine for the year was 741 tons, so that the importance of the "deep leads" being now fully proved, proportionate energy was bestowed on prospecting the volcanic ground. This resulted in the discovery of "deep lead" stream tin, at Rocky Creek, 19 miles W.N.W. from Emmaville, and at Surface Hill, 10 miles N.W. from the same township.

The working of the shallow tin gravels was extended to the Y. Waterholes Creek, and most of the creeks which drain from the Mole Tableland. In the latter district the Planet, the Dutchman, and Byrnes' tin veins were being prospected, and McMaster's, and Lewis and Griffiths', at Tent Hill.

1876.—A slight falling off in the yield of tin is recorded this year, which Mr. Gower attributes to the fact of the most easily worked ground having been exhausted. To cheapen the working of the poorer ground Mr. W. H. Wesley improved his tin-saving machine, so that it was rendered capable of washing 60 to 70 tons of puddled dirt daily, at a cost of 6d. per ton, including the removal of refuse (tailings and pebbles), and pumping sufficient water for two puddling machines. The Graveyard "deep lead" was proved this year, and the Y. Water Holes lead traced into deep ground. The discovery of the "deep leads" and tin lodes having added permanency to the industries of the district, the township became much improved as regards buildings, and a branch of the New South Wales Bank and a Telegraph-office were established.

1877.—The difficulty experienced by Europeans in working the poorer shallow grounds profitably, as evidenced in the preceding year by the devices of labour-saving machinery, combined with the low price of tin and a drought, paved the way for the coming of the Chinese. Accordingly numbers of Chinamen found their way this year to Vegetable Creek, from Cope's Creek, and Stanthorpe; and in these hard times managers of mines were glad to avail themselves of this cheap labour. The substitution of the tribute system for that of wages dates from this year. By this system working-men, instead of being employed on wages to raise tin for the companies, worked the tin themselves, paying all the expenses of the extraction and cleaning of the tinstone, and received in return for the ore from £18 to £20 per ton tribute from the companies.

Several tin veins were discovered this year, viz., the Gulf, Heiser's, Cadell's, Flagstone, and Silent Grove.

1878.—The price of tin still being low, and the weather dry, this year was marked by increased efforts on the part of managers of mines to economise labour. The greater part of the shallow stream tin ground was let to the Chinese, on the tribute system; and machinery driven by steam power extensively introduced for pumping, winding, puddling, crushing, and cleaning the stream tin. A tin vein was discovered this year on Paradise Creek, and Campbell's silver-lead lode on the south side of the Severn River (8 miles south-westerly from Emmaville). The Tent Hill Smelting Works are described as being in active work, 622¼ tons of tin ore being smelted in their furnaces in the course of the year. A saving of 30 per cent. was effected, according to Mr. Gower's calculations, by smelting the ore on the spot. The yield of tin this year showed a slight increase over that of 1877.

1879.—Better prices for tin ruled in the London market this year, and the drought having broken, and supplies of water become tolerably abundant, the yield of tin ore was largely increased,—from 1,935 tons 15 cwts. in 1878, to 2,715 tons 6 cwts. in 1879.

Important progress was made in proving the volcanic country by the discoveries of Griffith and Hammond's "deep lead," the "deep lead" at the north end of Red Hill found by Salmon and party, and of a rich patch of tin gravel under basalt, found by the Wesley Brothers in the north-east corner of their property.

1880.—The amount of tin produced this year, viz., 3,696 tons 5 cwts., considerably exceeded that of any previous year. This increase was due chiefly to the increase in yield of tin from the "deep leads," especially from Fox and party's newly discovered lead, the Wesley Brothers' mine, and Partridge and party's lead. At the lower end of the Graveyard lead, where there is a large area of unproved volcanic ground, Mr. H. Jew sunk a shaft 230 feet deep, hoping to reach tin gravel, but he was unable to bottom his shaft owing to the heavy influx of water, which stopped further sinking as soon as the sands were reached. A "deep lead" mine discovered at Ruby Hill, about 20 miles westerly from Emmaville, was sold this year to some Inverell capitalists for £2,000. The Wesley mine was floated this year for £40,000 and a portion of the mine taken on tribute by Flannery and party. "Deep lead" tin was found by Witherden and party at the Two-mile, over 2 miles west of Flannery's; and further attempts were made to prospect the Red Hill by Messrs. Hart & Swyny by means of a tunnel.

The population of these tin-fields in 1880 was estimated by Mr. Gower at 950 European miners and 1,200 Chinese.

1881.—The quantity of tin raised this year, 4,039½ tons, was the largest ever produced on these tin-fields. This, Mr. Gower considered, was due to the increased number of miners (principally Chinese) working such a large area of shallow deposits all over the fields. These could now be worked profitably with the improved price for tin and the good supply of water. The development of the main "deep lead" in the Wesley ground, by Flannery and party, added 480 tons of tin to the total output. Skinner's "shallow lead" was discovered this year, also Curnow's, Butler's, and the Torrington tin-veins on the Mole Tableland.

1882.—Lode mining was the principal feature of this year. Shafts were sunk at the Folkstone, Bark Hut, Torrington, Dutchman, Walleroo, Macintyre, and Graney's Veins. The yield of ore was probably about 3,170 tons. The population of the district is stated by Mr. Henry to be about 3,398.

1883.—There was a marked falling off in the yield of tin this year, the total amount produced being only 2,509 tons. The results of sinking shafts on some of the tin veins were not encouraging, and work was accordingly discontinued at the Gulf, Folkstone, and Macintyre Reefs. A small unproved patch of basaltic country was tested by Mr. Flannery at Maid's Valley, near Silent Grove, 23 miles north of Emmaville. Stream tin was found in the sands but not in sufficient quantity to be worked to advantage. The most important event of the year was the discovery by Barry and party of rich tin wash at the Two-mile, over 2 miles west of Mr. Flannery's old workings in the Wesley ground. Stream tin had been found here by Mr. Witherden in 1880, but this discovery by Barry and party was of great moment in proving the richness and extent of the tin gravels here and so establishing the certainty of the existence of payable "deep leads" between this point and the Wesley ground.

1884.—Owing to the low price of tin, and the difficulties met with in prospecting the main Vegetable Creek deep lead, below Bailey's Mine, the quantity of ore raised was less than that for the preceding year. The yield of vein tin, however, showed a marked increase.

The following is the return given by Mr. W. E. Henry :—

	tons.	cwts.	qrs.	lb.
Lode workings	312	13	0	10
Deep lead workings	818	11	3	6
Shallow lead „	1,109	18	3	26
	2,241	3	3	14

A new lead was discovered this year at the Race-course, close to the line of water-parting, between the Y. Water Holes and Graveyard Creek.

Cunneen and Company struck good wash on the main Vegetable Creek deep lead, below Bailey's Mine, at a depth of 118 feet.

Several shafts were bottomed by Hart, Flannery, & Co., in H. Gordon's portion No. 3, parish of Hamilton. Some of these, after being sunk through the basalt, were bottomed by means of boring-rods, the bore being tubed with iron. By this means the Company were enabled to obtain samples of the drift beds from any depth, and ascertain whether they were tin-bearing, without having to resort to the expense of bottoming shafts on to bed rock through wet running sands.

The batteries at the Ottery and Dutchman Mines were in full work this year, and lode mining was actively carried on at the preceding mines, as well as at Butler's, the Torrington, &c. A silver vein was discovered at the Little Plant Creek, near Emmaville, now known as "Webb's Silver Vein," and several similar veins were found at Pye's Creek.

1885.—The output of tin this year showed a slight improvement on that of the preceding, and is estimated by Mr. J. M. Sheahan, the Mining Registrar, as follows:—

	tons.	cwts.	qrs.	lb.
Lode workings	352	2	2	21
Deep lead workings...	945	7	1	14
Shallow "	1,207	15	0	19
	2,505	5	0	26

The Race-course lead, near the head of of the Graveyard Creek, continued to yield good wash-dirt at depths of from 30 to 50 feet.

Rich wash was obtained on the Vegetable Creek deep lead from Fox's, Bailey's, and Cunneen's mines.

Cadell, Reid & Co. bottomed several deep shafts between the preceding mines, and Barry's without finding tin.

The Chance Tin Mining Company struck a deep lead at 160 feet from the surface, in portion 49, parish of Hamilton. The wash-dirt yielded 50lbs. of ore to the load. The character of this wash, and the level of this channel, imply that this is an upper lead, and not the main lead.

Crushing was commenced at Butler's (Dolcoath) Tin Mine, the plant consisting of a 12-horse engine, a battery of ten stamps, and four buddles. Crushing was resumed at the Torrington battery, and improvements were introduced into the tin-saving machinery. The yield of ore from the veins shows an increase of 40 tons over that for the preceding year.

1886. The Mining Registrar's report for this year shows a decrease in the yield of tin as compared with that of the proceding year. The yield is stated to be:—

	Tons.	cwts.	qrs.	lb.
Lode workings	169	13	0	0
Shallow working	761	1	0	0
Deep lead workings	962	8	0	13
	1,893	2	0	13

This falling off is attributed to the exhaustion of the shallow workings, the want of capital to further develop the deep leads, and to the departure of many of the tin miners to the newly discovered gold-field at Fairfield, near Tenterfield. Among the shallow workings, the Great Britain, and Moore & Co.'s ground on Vegetable Creek yielded, respectively, 124 tons, and 65 tons of stream tin.

Of the yield from the deep leads 230 tons were raised from A. Cadell's Race-course lead, and 223 tons from Bailey's mine. Hart, Cadell, Reid & Co. bottomed several more prospecting shafts, by means of boring-rods and tubes, in H. Gordon's portions 1 to 4 in the parish of Hamilton. In two of the shafts the drift was found to be tin-bearing.

Webb's Silver Mining Company's silver vein, at the Little Plant Creek, is stated by the manager, Mr. T. G. Davey, to show marked signs of improvement, being 7 feet wide in places, at a depth of 210 feet from the surface.

SUMMARY.

Since the discovery of tin-stone in the water-holes of Vegetable Creek, in 1872, the Vegetable Creek district has continued to produce large quantities of stream tin annually. In ten years' time an obscure corner of a "run" has been transformed into a prosperous township, which, with the surrounding district had, in 1882, a population of 3,398. Stores, hotels, and dwellings, built of sawn timber and roofed with corrugated iron, have sprung up on the site once occupied by the tents and bark huts of the original prospectors. The old Court-house and Post and Telegraph Offices, built of wood, have been replaced by substantial brick buildings; and the township is now provided with an excellent hospital, 3 churches, 1 public school, a branch of the Bank of New South Wales, and a Mining Institute, with which last is incorporated a lending library. At Tent Hill, 3 miles north-easterly from Emmaville, another township is springing up round the Glen Smelting Works, which now smelt over 2,000 tons of tin ore annually. Exclusive of the old battery, at Battery Mountain, there are in the district six batteries for crushing tin ore. Tin ore was, at the time of its first discovery, won only from shallow deposits of sand, gravel, and "cement." The richer parts of the tin ground passed rapidly out of the hands of working miners into those of capitalists. Prospecting for stream tin in surface gravels led to the discovery of the "deep leads," which, as will be subsequently shown, are old valleys buried under thick masses of lava and volcanic dust.

Continued prospecting of surface tin gravels led on by degrees to the discovery of the tin veins. The shallow workings produced their largest yield of tin ore in 1881, since which time their productiveness has constantly declined. The "deep leads," which were first worked in 1883, now yield far more ore than the shallow gravels, and will, probably, continue to form a valuable source of stream tin for many years to come. Some idea of the extent of the unworked "deep lead" country may be formed from the fact that, out of a total length of 49½ miles, only 3½ miles have been worked; and the working of this comparatively small area has occupied rather more than eleven years. The tin veins have not yet been fairly tested, and it would be premature as yet to predict their payability and permanence. To this brief sketch of the discovery of tin and history of tin-mining, at Vegetable Creek, succeeds a general view of the broad physical features of the tin-bearing country.

PART III.

PHYSICAL GEOGRAPHY.

The extent of tin-bearing country, geologically examined, in this district has an area of about 800 square miles. The district lies on the western slope of the Great Dividing Range, between the 151st and 152nd meridian east from Greenwich, and the 29° and 30° parallel of south latitude, and is over 90 miles distant from the coast, the nearest point of which lies to the east-south-east. There are two main lines of water-parting, and four of water-passage, all having, on the whole, a westerly trend, the general fall of the country being in that direction. The two main lines of water-parting are offshoots of a spur, which strikes west from the main coast range, leaving it at a point 25 miles north-east of Glen Innes. From here, after holding on its westerly course for 15 miles, this line of water-parting splits into these two branches at a point 2½ miles south-west of Deepwater. The main branch still trends westerly, passing to the south of Tent Hill and Emmaville to a point 1 mile north of Strathbogie Station, a distance of 20 miles. From here it strikes in a north-westerly direction for another 20 miles to the north-west corner of the map, and eventually dies out towards the confluence of the Dumaresq and Macintyre Rivers, which takes place 64 miles further to the north-west. The shorter subordinate branch, after leaving the main spur near Deepwater, shoots north for 10 miles, then west for 8 miles, then north-westerly for 7 miles, when it dies out on the Mole Tableland, near the head of Carpet Snake Creek. The main line parts the watersheds of the Dumaresq and Severn Rivers, the latter eventually joining the Macintyre and taking its name. The subordinate spur forms the water-parting between the Beardy River and the Deepwater or Mole River, tributaries of the Dumaresq. The whole drainage of the district is thus discharged into the Dumaresq, and, becoming mixed with the waters of the Darling, is delivered through the channel of the Murray into the Great Southern Ocean.

The area, geologically examined, comprises one complete basin, viz., that of the Beardy or Glen Creek, lying between the main and the subordinate spurs, and a portion of the watershed of the Severn on the south, and the Mole or Deepwater River and the Dumaresq River on the north and north-west. The main line of water-parting, where it enters the map near the south-east corner, is characterized by low hills and shallow, flat-bottomed valleys. Hard bosses of a fine-grained, bluish-grey granite show through the turf on the hill slopes, while the valley flats are covered with a deep soil of a greenish-brown colour, resulting from the waste of the granite. These flats are generally well grassed and open, while the hills are thinly timbered, chiefly with peppermint, the trees being from 30 to 40 feet high. The slopes on each side of this water-parting are very gradual, especially on the south. To the north the watershed, as it approaches Robertson's or Glen Creek, becomes deeply furrowed by the creeks, and in places is almost precipitous. Near Emmaville the character of the Range changes somewhat. The fine-grained granite is succeeded first by a belt of dark blue porphyrite, and then by grey quartz-porphyry in which thin veins of tinstone can occasionally be traced. Where this formation obtains the prevailing vegetation is red gum, dogwood, and grass-tree. The rock comes everywhere to the surface, and being naturally much jointed, is broken up by frost, heat, and water, into a rubble resembling shattered flagstones. From here the water-parting runs south-west for a mile and a half, again crossing the belt of dark porphyrite, and entering a red sandy flat, thickly covered with scrub, chiefly wattle. Where forest trees prevail the principal timber is stringy-bark, which reaches a height of from 50 to 60 feet. The water-parting now follows this red scrubby country, which runs in a belt, widening towards the west. From here to the Graveyard the red country is studded with the shafts of the tin-miners, the white "spoil-banks" of clean quartz sand and white pipeclay contrasting finely with the deep brick red of the soil and dark green of the mimosa. At the Graveyard the red soil passes into a hard red cindery rock, locally known as "ashes" or "red clinker." From here, for 4 miles west, the range maintains its previous character, being still composed of low, red, scrubby hills, forming good land for agriculture and vine-growing. Thence to a point 1½ mile north of Strathbogie head station the country on the dividing range becomes more open, and its outline less broken, having now the appearance of a smooth, nearly flat, mass of greyish-green to brown rock, its rough lumpy surface weathering into blocks with rounded edges, and the steam-holes, which give the stone in places a spongy appearance, clearly showing that it is a rock of volcanic origin. The slopes on either side pass into grassy flats, with rich, black soil. The southern margin of the lava, where it has been deeply trenched by the creeks, shows all the characteristic scenery of a volcanic country, the nearly flat rocky plateaux terminating abruptly in steep escarpments. The prevailing timber is white gum, white and yellow box, and apple. Throughout the rest of its course as shown on the map, the character of the main water-parting varies little from the above description, generally following the red hills, but in places leaving them for the hard granite rocks. The southern watershed, the drainage of which is received by the Severn, is rocky and precipitous, so as to make access to the river extremely difficult; the creeks for the last mile or two, before they enter the river, becoming hemmed in between steep walls of a hard grey felspar-porphyry or pink granite. All this watershed, with the exception of the patches of volcanic rock shown on the map, is so rocky and rugged as to be almost worthless for pastoral purposes. The part of the watershed which lies to the north of this line between the south-east and north-west corners of the map very much resembles that just described, especially towards the north-west end, but on the whole is easier of access for stock. Low hills of hard dull blue claystone with sharp crests, and deeply channelled gullies occupy the central part of the area, which is timbered chiefly with ironbark and red gum. Returning to the point where the subordinate spur leaves the main one near Deepwater, the line of water-parting between the Beardy and Mole Rivers at first runs northerly for 10 miles, chiefly along a sheet of stony lava, having a gentle slope to the south. The volcanic country is open box forest with white and red gum and stringy-bark. The western edge of the lava has been deeply eroded by the small tributaries of Castle Rag Creek. Along its western boundary it sinks gradually into undulating thinly-timbered country, having a slight declivity to the south-west. At the north-east corner of the parish of Wellington Vale the water-parting turns sharply westward, passing over the principal orographic feature of the district—the Mole Tableland. This is an elevated isolated platform of granite, the contour of which, when seen from a distance, is tolerably even with a slope increasing westwards from 20 feet to 140 feet per mile. At a distance of 1½ miles west from the sharp bend in the range the water-parting crosses the highest point in the district—Battery or Catarrh Mountain, which is 3,970 feet above the sea-level as measured by aneroid. Near the line of water-parting the Mole Tableland is characterized by gently sloping hills with shallow sandy flats, and spongy swamps; the gathering grounds of the tributaries of the Mole, Glen, and Dumaresq Rivers. Here and there huge dome-shaped masses of rock rear themselves above the stringy bark and pine trees, slightly breaking the general soft flowing outlines of the landscape. The dividing range as it sinks away towards the west, becomes split up into a number of bold spurs with a rapid descent into the valleys of the Dumaresq and Glen Rivers. The fall here is so steep as to make most of this country practically inaccessible. Following down the creeks which take their rise in the Mole Tableland, the scenery becomes wilder as the streams gather force; the wide swampy sand flats, and wooded rolling hills, give place to deep ravines with streams of clear water sliding over masses of rock covered with black lichen, or plunging over slippery cataracts 50 to 60 feet deep. Before these creeks reach the Mole, Glen, and Dumaresq Rivers a marked change is observable in the physical features. The irregularly hollowed channels, shut in by lofty walls of granite, settle into regularly formed V-shaped watercourses with banks sloping steeply, but seldom precipitous. The broad swelling rock masses and round tors of the tableland waterpartings give place to knife-edged ridges of hard jointed claystone, breaking into cubical blocks with sharp edges like freshly broken road metal. Stringy-bark and pine disappear; and the bareness of the hills is hardly hidden by the growth of ironbark, red gum, dogwood, and grasstrees. At the infall of the north-western tributaries of the Glen River, and the southern tributaries of the Mole River, the incline is too steep to allow of the formation of alluvial flats; but on the Dumaresq River, between its confluences with these rivers, alluvial plains have been formed, extending back from ½ to over 1 mile. Following down these grassy alluvial plains in a south-easterly direction, the confluence of the Beardy and Dumaresq Rivers is reached, the lowest point measured in the district, 1,120 feet above the sea. The Dumaresq here forms a fine sheet of water, 100 to 150 feet wide, constituting the boundary between New South Wales and Queensland. Turning now up the valley of the Beardy River, and going in a south-easterly direction, well grassed alluvial flats fringe the banks, narrowing as the stream is followed up, until at 6 miles from the confluence the river becomes hemmed in between steep rocky slopes of the dark blue claystone described above. A little higher up the features change somewhat; the river still flows in a narrow rocky channel over the striped claystones, but in places a coarse conglomerate is seen overlying the claystone and underlying a hard white massive quartz-porphyry. The presence of this last-mentioned variety of rock is invariably marked by precipitous slopes and sharp pinnacles. Irregular cracks traverse its mass, and under the influence of the weather it becomes split up into large angular blocks of a prevailing white or grey colour, tinged with pink or reddish brown, and closely resembling much of the rock found on the Severn watershed already described. Leaving the valleys of the Beardy at the Fishing Grounds, and going due south, a grey granite forms the side of the valley, and at the point where this formation ceases, the incline becomes very steep, and a distinct bed of coarse well-worn shingle and sand overlies the granite. Above the loose gravel comes a dense mass of hard lava. The belt of open level country with its rich black soil, and clumps of white gum, white box and apple, which stretches south from the Fishing Grounds, marks the extension of this lava in that direction; and following its southerly trend the observer finds himself gradually brought back to the point on the main water-parting, near where the stony lava was first met with on the main range, from which he is led to infer that the volcanic rock, which was found overlying the shingle at the Fishing Grounds, belongs to the same mass as that in the main parting near Strathbogie. Going westerly from here a run of lava is seen to diverge from the main water-parting to the left, and following this northern branch to its source the observer is brought through the heart of the present mining "deep lead" country to the township of Emmaville.

The Rivers which drain the watersheds above described are the Mole, the Dumaresq, the Beardy, and the Severn. The Mole River takes its rise in the main Coast Range, 12 miles west of Deepwater. The principal tributaries which it receives from the area shown on the map are Castle Rag Creek, Pye's Creek, and Oakey Creek. The Dumaresq, which divides New South Wales from Queensland, and forms the north-west boundary of this map, is the main drainage channel of this part of the country. Between Mingoola and Maidenhead it averages about 50 yards in width. The bottom of its channel is from 10 to 15 feet below the level of the surrounding alluvial plains. In June, 1884, at the time of my visit, scarcely any water was flowing, but abundance of beautiful clear water was lying in the long deep pools separated from one another by stretches of shingle. These fine sheets of water are, I am informed, full of fish, chiefly cod. A dark line of river oaks, rising out of the tall rank grass, marks the course of the river as it winds through the plain. The Glen River, called also the Beardy River, the Glen Creek, Robertson's Creek, and the Nine-mile, drains the central and most important part of the tin-fields, the whole of its basin lying within their area. The Glen River takes its rise in the southern spurs of the Battery Mountain, and has an average width of about 15 yards. The fall from its source downwards is as follows: For the first 10 miles from its source, 100 feet per mile; for the next 15 miles, 66 feet per mile; and the last 11 miles, 27 feet per mile. On its course to the Dumaresq it receives in succession as tributaries from the north, Bark Hut, Bullock Swamp, Bridge, Highland Home, Land's End, and Gulf Creeks, all draining from the Mole Tableland. From the south it is fed from its source downwards by the Tent Hill, Boiling Down or Hell Hole, Happy Valley, Big Plant, Little Plant, Vegetable, Swamp Oak, and Rocky Creeks. Of these tributaries by far the most important, from an economic point of view, is the Vegetable Creek. This stream rises in low wooded hills of greenish grey quartz-porphyry, about 1 mile north of the main waterparting, and 2½ miles east-north-east of Emmaville. Its average fall, from its source to its junction with the Beardy, is 100 feet per mile. The Severn River drains the southern part of the watershed of the main waterparting shown on the map. Its source is in the Cordillera, to the south of the spur which divides its waters from those of the Deepwater River. The average width of its channel is about 30 yards, and the average depth of the channel about 10 feet. As compared with the Dumaresq, the channel of the Severn is rocky, and its banks so precipitous as to render it impossible for stock to get access to the water along the greater part of the frontage. Except in dry seasons there is a strong current of water always flowing. The scenery along its course is very wild, the river sweeping swiftly in places through steep gorges, over sloping ledges of dark felspar-porphyry, and here and there breaking over small waterfalls, which scoop out deep pools beneath. Where the fall in its channel is less rapid the river spreads out into long sheets, fringed by narrow strips of alluvial ground. Between Strathbogie and Ruby Hill, 13½ miles, it has an average fall of 65 feet per mile (885 feet). The principal streams which feed this river on the part of its watershed shown on the map are, Y. Water Holes, Pipeclay, Eight-mile Water Holes, and Spring Creek.

PART IV.

METEOROLOGY.

Rainfall.—The water-supply of the tin-fields is almost wholly dependent on the local rainfall.

The following measurements were made by Mr. Hugh Gordon, of Strathbogie, with a 6-inch rain-gauge:—

1874	Total rainfall,	31·08	inches.
1875	„	29·14	„
1876	„	35·18	„
1877	„	26·39	„
1878	„	32·56	„
1879	„	58·44	„
1880	„	27·96	„
1881	„	22·52	„
1882	„	38·05	„
1883	„	29·83	„
1884 to date, Sept. 28th ...	„	21·47	„

Similar measurements, made by Mr. A. Cadell, C.E., at Emmaville, for the years 1882 and 1883, agree closely with those made by Mr. Gordon. The average rainfall of the district for the ten years preceding 1884 may be taken as 33·11 inches, a rainfall which compares well with that of the Eastern counties of England. Want of water was felt in the years 1874, 1877, and 1881, but in each of these years sufficient rain fell to have answered most of the requirements of mining, if it had been properly stored.

The distribution of the rainfall throughout the months of the year, for the 10 years preceding 1884, is shown on the following table, compiled from Mr. Gordon's records, the months being arranged in order according to the amount of their rainfall:—

February	3·69	inches.	January	2·82	inches.
September	3·33	„	April	2·62	„
December	3·31	„	November	2·55	„
October	3·12	„	May	2·42	„
March...	3·06	„	August	1·72	„
July	2·84	„	June	1·59	„

The winter months are, therefore, drier than the summer; the spring rains are more constant than the autumn; and the month most to be depended on for rain is February.

Snow has fallen occasionally at Strathbogie, but only once in the past forty years did it lie in sufficient quantity to make the ground white, and on that occasion it was from 6 to 9 inches deep.

Hailstorms occur during the summer months, and sometimes in winter. The hailstones are frequently large and do considerable damage to fruit trees; the path of these storms through the bush can often be tracked by the litter on the ground of freshly-broken twigs, the trees in some cases being almost stripped of their leaves, and their bark bruised and deeply pitted by the hailstones.

During June, July, and August the **Thermometer** usually sinks below freezing point at night; the greatest cold registered by Mr. Gordon, at Strathbogie, was 5° 30′ Faht., and he has frequently known the temperature to be as low as 12° and 8° Faht. In spite of these sharp frosts very little ice forms on the creeks and waterholes, the warmth of the sun during the day generally sufficing to thaw the film that has crystallized during the night. The maximum shade temperature registered by Mr. Gordon was 106° Faht., in January, 1884. The maximum temperature in the sun was 149° some seven years ago.

Classification of the Vegetable Creek Rocks—continued.

Age unknown..		DIORITE dykes, greenish grey, possibly connected with the eruptive rocks of tertiary age.
		HYPERSTHENE-GARNET-DIORITE, dark green, occurring as metalliferous dykes, containing sulphide of zinc, copper pyrites, and a little silver.
Palæozoic	Permian(?)	2. GRANITE (*b*), coarse-grained and intrusive, traversed by veins of eurite and quartz containing tinstone, associated in places with wolfram, magnetic, and iron pyrites, arsenical pyrites, and to a limited extent with bismuth and molybdenite. Seen from a distance shows smooth outlines, rising here and there into bold isolated hills, which latter on nearer view have a rugged aspect, being built up of huge dome-shaped masses of nearly bare rock. The prevailing timber is stringy bark and pine. (*a*) Intrusive hornblendic granite. *Total area*—297 square miles.
Age unknown..		1. (*c*) Intrusive red quartz-porphyries, containing red orthoclase, and passing into aplitic granite. (*b*) Intrusive white quartz-porphyries. (*a*) Intrusive hornblendic quartz-porphyries and breccias, associated with grey and dark blue porphyroids. The age of the porphyroids is unknown. The tin-bearing portion of the hornblendic quartz-porphyries, which pass into euritic granite, may perhaps be correlated with the tin-bearing granite. Is characterized by sharp-edged cliffs, the rock coming generally to the surface, and splitting into large harsh blocks, affording scant nourishment to stunted trees of ironbark and red gum, and an under-growth of dogwood and grasstree. *Area*—71 square miles.
Palæozoic	Upper Silurian (or Siluro-Devonian)	Yellowish brown to olive green clay shales, passing into dark blue and black claystones with bands of leaden-grey felspathic quartzite, and beds of dark grey pebble conglomerate. An interstratified bed of blue siliceous grit shows casts of bryozoa and minute shells. The dark shales in one place show obscure traces of plant remains. This formation is characterized by sharp-crested hills of blue claystone and olive green clay shales, timbered with ironbark and red gum. *Area*—234 square miles. *Thickness* not ascertainable owing to the folding and dislocation of the beds, but probably not less than 5,000 feet.
	Age unknown	PORPHYRITE.—A dark bluish black to greenish black rock, in appearance somewhat resembling basalt, but containing large glassy crystals of felspar and hornblende crystals, partly altered into epidote. The joints in this rock in places are filled with thin seams of epidote. *Area*—18 square miles.
	„ „	GRANITE.—Metamorphic(?)—A fine grained leaden-grey rock, consisting of an intimate crystalline admixture of felspar, quartz, magnesian mica, and hornblende. There is a gradual transition from this rock into the porphyrite, and it may represent the extreme stage of alteration of the Upper Silurian rocks. No metalliferous deposits have been found in this rock in this district. The country occupied by this formation is characterized by undulating hills, thinly timbered with peppermint, and by open grassy plains. *Area*—62 square miles.

PRINCIPLES OF CLASSIFICATION.

The age of the deep leads is fixed approximately by the nature of their fossil plants, a number of which have been determined by Baron Von Ettingshausen, and are considered by him to contain many forms common to the early Tertiary flora of Europe.

With regard to the geological age of the older igneous and sedimentary rocks the evidence is very meagre. The fossils found by me in these rocks at the three points shown on the map are not sufficiently definite to afford much clue as to the age of the beds.

The rocks have therefore been grouped provisionally on lithological and stratigraphical grounds as Upper Silurian, though it is quite possible that they may be more nearly related to the Devonian system.

Where a chronological sequence has been made out for the Palæozoic rocks, the probable Silurian age of these sedimentary rocks has been taken as the basis of the classification. The age of the intrusive tin-bearing granites has been stated as Permian, on the assumption that they may be correlated with granite at Ashford and Newstead, which has tilted carboniferous strata, and is thus newer than the carboniferous. No granites in the colony have appreciably disturbed the Triassic rocks, hence the age of the tin granites has been assumed to be Permian.

POST-TERTIARY.

Holocene, or *Recent*, and *Pleistocene*.

The area occupied by these deposits has a superficial extent of about 9 square miles.

The greater part of this tract is embraced by the alluvial flats stretching along the banks of the Dumaresq River from Mingoola to Maidenhead.

Recent and Pleistocene gravels also form small patches along the banks of the Beardy River, 4 miles above its confluence with the Dumaresq, and on the banks of the Severn River at Strathbogie. Under this head are also included the less extensive and shallower deposits of sand and rubble near the sources of the Vegetable Creek, and of the Nine-mile Creek, near Wellington Vale, besides the sand swamps of the Mole Tableland, as Paradise, Trollope, Bullock, and Wyndham Swamps, with a few very small patches of calcareous tufa.

The gravels of the Dumaresq, Beardy, and Severn Rivers consist of coarse waterworn pebbles of claystone, dark porphyroid, quartz-porphyry, and granite. No estimate can be formed of their depth, as no shafts nor borings have been made through them, nor has any attempt been made, as far as I am aware, to prospect them for stream tin, miners having been deterred from doing so by the certainty of meeting with large quantities of water, and by the prevailing impression that the stream tin in these beds would not be sufficiently concentrated to be payable.

At Vegetable Creek the area occupied by these beds is about 540 acres, and has produced from the year 1872 to 1884 over 15,000 tons of tin ore. This deposit extends for about 5 miles down the Vegetable Creek from its source. At the upper end, near the Great Britain Mine, the deposit varies in thickness from 3 to 13 feet, the following being a characteristic descending section :—

3 feet.—Grey and rusty sandy clay with rubble of quartz-porphyry, passing into 7 feet grey sandy talus ; at base a hard breccia, = " cement."

2½ feet—3 feet.—Rubbly breccia, consisting of angular and subangular blocks of quartz-porphyry up to 1 foot in diameter, set in a white cement.

Black grains of stream-tin, resembling shot, are sprinkled through this last bed very plentifully.

The cement is composed chiefly of clayey material resulting from the decay of the quartz-porphyries, which form the neighbouring hills, and is hardened in places by brown iron ore and silica.

The tin-bearing breccia, forming a thin, nearly flat, flooring to the valley, may be compared to a natural concrete, the fragments of quartz-porphyry and grains of tinstone being firmly set in the cementing medium.

Many of the blocks of quartz-porphyry contain thin veins of tin-bearing quartz. Well rolled quartz pebbles are exceptionally found in this breccia.

PART V.

GENERAL GEOLOGY.

The various physical features of the district, as sketched above, are intimately related to its geological structure.

The following is the provisional classification proposed for the rocks of the Vegetable Creek District:—

Classification of the Vegetable Creek Rocks.

Post-Tertiary	Post-Pliocene	Holocene, or Recent Pleistocene.	Clay, sand, gravel and rubble; occurring in small swampy flats, near the sources and along the banks of creeks, or in open plains along the valley of the Dumaresq River; usually more or less stanniferous. Living species of fresh water shells, and natives' stone hatchets are associated with these recent deposits. *Area*—About 9 square miles. *Thickness*—From 1 ft. to at least 20 ft.
Tertiary		Pliocene (?)	Coarse river gravel, overlying basalt. *Area*—9 acres. *Thickness*—10 (?) ft.
		Eocene, in part.	3. BASALT, capping the tin sands of the "deep leads"; in some places overlying, in others underlying the laterite; characterized by fine open country, flat and timbered with white box, white gum, and apple. *Area*—53 square miles, 260 acres. *Thickness*—From a few feet to about 300 feet.
			2. LATERITE, locally known as "red clinker," or "ashes," consisting of red and yellow beds of volcanic dust and scoriæ, passing in places into an earthy pisolitic ironstone; overlies or is inter-stratified with the basalt; characterized by scrubby country, with red dusty or cindery surface. *Area*—11 square miles, 577 acres. *Thickness*—30 to 40 ft.
			1. (*b*) GRAVEL, sand and clay of the deep leads, mostly capped by basalt or laterite, but partly interstratified with the volcanic rocks. The oldest of the clay beds enclose fossil leaves, probably of Eocene age. *Thickness*—From a few feet to 80 ft. *Area*—Unknown, as the underground extent of this formation is hidden by the volcanic rocks. The total length of these beds is 49½ miles.
			1. (*a*) QUARTZITE and sinter, locally called "grey billy," occurring in irregular patches and concretions in the deep lead gravels, especially near the junction of the latter formation with the basalt. *Area*—About 40 acres. *Thickness*—1 ft. to 5 ft.

these beds must have been very vast, and prolonged probably into the miocene, if not into the pliocene period. The denseness of the scrub, which in most places covers the surface of the laterite, renders an examination of its superficial features somewhat difficult. The features of the basaltic lavas may be more easily studied, the area occupied by them being fine open country, and fair sections being obtainable in the banks of creeks.

Topographically considered the Older Tertiary volcanic rocks, exclusive of small outliers, may be ranged in five main masses :—

1. The Vegetable Creek, Graveyard, and Kangaroo Flat Leads.
2. The Springs Lead and the volcanic country in the eastern half of the Rocky Creek Lead.
3. The Ruby Hill Lead and the eruptive rocks in the western half of the Rocky Creek Lead.
4. The Wellington Vale Lead.
5. The Maid's Valley Lead.

The outlines of the volcanic rocks, as traced on the map, show them to be straggling masses, having a length from 2 to 14 miles, and a width from 10 chains to 2 miles.

Their general shape suggests that the materials of which they are formed were once in a pasty or fluid condition, as their surface being tolerably even, and having a steady, uniform fall, corresponding with the inclination of the surface of the main drainage basins, their appearance resembles that of streams of slag from a blast furnace, the lava having moulded itself into the shape of the country, so as to take a cast of the old land surface.

Where the material forming the mould or rim rock, enclosing the lava streams, is softer than the lava cast, the volcanic rock has been left standing high above what were once enclosing hills, so that after a prolonged course of subaerial waste, a line of water parting has actually been established immediately over the site of an old river channel.

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More rarely the volcanic rocks proving softer than those on which they rest, Nature has partially restored the former physical features by re-excavating the old valleys at the expense of the lava.

Basalt, or "blue metal," has a superficial area of 53 square miles 260 acres, and a thickness of from a few feet to 300 feet, the average thickness being 200 feet. The surface of the basalt, which was probably originally rough and bristling, has been softened and smoothed by rain and frost, so that it is now for the most part covered with a rich black or chocolate soil, affording fine open country, excellent for pasture and agriculture. Where the rock comes to the surface it shows as rounded lumps of dark brown to black stone, passing downwards into a compact rock. In places, especially near the hills of red laterite, the surface of the lava has a blistered aspect, the stone being so full of air-cells as to be almost spongy. The under surface of this formation is in most places equally cellular. At first sight the basaltic country seems to be formed out of one homogeneous mass of lava. A closer examination, however, proves that two at least of the five main masses, those at Vegetable Creek and Wellington Vale, are built up of a number of sheets, which have been erupted at different dates. The line of separation between the sheets is marked often by a sudden change in the character of the rock from a tough stone to a soft unctuous clay, or by a parting of laterite or gravel. In Skinner's hard rock shaft, in portion 1, Hamilton, as shown on section No. 2, there is conclusive proof of at least two flows of lava belonging to different periods. This shaft was sunk through 100 feet of soft basalt on to beds of fine sand and clay 25 feet thick, and the latter were found to rest on a water-worn surface of hard basalt. A similar phenomenon was observed down the "lead" at the Wesley Brothers' shaft, in portion 137, Arvid. In the latter case, after passing through several distinct flows of basalt, a layer of gravel was struck at 247½ feet from the surface. This gravel also reposed on an irregular surface of basalt. There is evidence, therefore, in both these cases, of the existence of distinct sheets of lava, neither of which can have been contemporaneous. The lower one must obviously have been formed first, and, after its eruption and subsequent cooling, a stream of water cut its way across the surface and laid down the gravel; then came a second series of outbursts of lava, covering over the gravel with a thick stony coping. The great diversity in the appearance and hardness of the lavas is probably also due more to differences of age than of chemical composition. The typical lava of the district is of a hard dark green, almost black, finely crystalline stone, with a prevailing dull grey to dark greenish-brown surface. The rock mostly occurs in compact sheets, but in places, as at Kangaroo Flat, in portion 200, Arvid, and in portion 187, Scone, it consists of a volcanic conglomerate composed of slaggy cakes of nearly black lava, with a resinous lustre, embedded in a base of crystalline basalt. At Kangaroo Flat the volcanic conglomerate is almost wholly composed of fragments of black glassy lava, cemented by carbonate of iron. The greatest variety, in the general appearance and hardness of the lavas, is to be noticed near their points of eruption. Near Emmaville, for example, the lava in Griffiths' "deep lead," in portion 723, Strathbogie North, and that in 240, Strathbogie North, is of a reddish brown to pale purple colour, streaked and spotted with white, and so soft as to be easily cut with a pocket-knife. The general appearance of the stony lava, when decomposed, is that of a greenish-grey soapy clay; and as this is passed through, from the surface downwards, the rock generally becomes harder, round kernels of stone becoming more and more frequent, until the whole mass settles into a very hard and compact dark green or blue rock. The different flows of lava in these volcanic masses either rest immediately above each other, the newer completely overlapping the older, or alongside of one another, with only a partial overlap, if any. If a map [*see* section No. 8, S–T, of the Wellington Vale leads] could be made to show the relative positions of these different sheets of lava, it would probably be of considerable use to miners in indicating the lines which separate the newer and older leads. The frequent overlapping, however, of the older currents by newer, makes such a work almost impossible. In some cases the existence of such a line is evidenced by slight changes in the soil, and an outcrop of brown iron ore along the margin of the older flow. The structure most noticeable in the lavas is the prismatic, the sheets being divided by irregular joints, formed during cooling, into rude columns having, usually, six sides; these columns, where they are exposed to the atmosphere, weather into spheroids. This structure is more prevalent in the older flows than in the newer. The under surface of the lavas, for a distance of from 2 to 3 feet above their base, is full of steam holes. In the older lavas these holes are filled with calcite, as at Pipeclay Gully, near Strathbogie; or with chabazite (called by the miners congealed steam,) as in the basalt of portions 744, Strathbogie, and in Reynolds' selection, portion 512, parish of Scone. The basalt, through which the Wesley Brothers' 255-feet shaft was sunk, resembles an amygdaloid, as it contains numbers of almond-shaped lumps of greenish earthy mineral like halloysite, as well as bright clear crystals of chabazite, the cells being from 1 to 2 inches in length. The base of the lava sheets, at the point of contact with the underlying clay and gravel, though generally even, occasionally undulates. At Hall's workings at Kangaroo Flat, and at Hall's Sugarloaf, where this phenomenon is most noticeable, the whole of the soft beds over which the lava flowed, have been thrown into waves—as shown in section No. 6, L. to K.—the steep side of the wave facing the direction from which the lava flowed, and the lesser slope inclining away from it. The average height of these waves from crest to trough is 4 feet. These rolls or waves of sand and pipeclay were no doubt formed by the passage over them of the molten lava. Flowing from the south down the old valley near Kangaroo Flat, which they now fill, the lava torrent with its great weight would squeeze up the soft clays and sands fronting it, which would thus be ridged up along the line of the terminal bank of the advancing stream, until the heat and pressure of the lava rendered them sufficiently coherent for it to creep over them. A further extent of soft clays and sands would then be ploughed out, and another ridge formed to the north of the first. Mr. Warrell, who for some years superintended Hall's mines at Kangaroo Flat, informed me that there these ridges almost invariably run from east to west, and that he had no doubt from the inclination of the slopes on either side that lava had flowed from the south. In the spaces between the crests of the waves the lava comes right down on to the hard palæozoic rock, considerably increasing thereby the cost of working the tin gravels. Fluxion structure causing the lava to weather in fine parallel bands may be observed on the summit of the basalt cone in portion 600, parish of Annandale.

Composition.—All the tertiary lavas of the Vegetable Creek district are essentially basalts of the common plagioclase-basalt type. Thirty-six slices of these lavas have been prepared for examination under the microscope. the rock being ground down for the purpose into extremely thin slices so as to become transparent. These slices show the lavas to be composed of plagioclase felspar, augite, and olivine, with magnetite and titaniferous iron, Under the microscope some of the stone has the appearance of a piece of parquetry, the plagioclase felspar forming a sort of framework or setting for the crystals of augite, olivine, and magnetite. In other slices the felspar crystals are quite separate from one another, and their general appearance under the microscope may be compared to that of broken twigs drifting down a stream, the crystals being ranged end on to the current of the once molten material in which they have been, as it were, frozen. The ends of the felspar crystals are often frayed out like a piece of broken matchwood, and the crystals, under polarized light, show beautiful differently-coloured bands characteristic of the repeated twinning of the crystals. The olivine is easily recognizable as clear transparent grains, with rough pitted surfaces becoming green or reddish brown along the margins and cracks in the crystals. When much decomposed, as at the " Gap," Rocky Creek, it passes into a brownish red mica, probably rubellane. The colour of the augite varies from straw colour to deep purplish brown. The magnetite shows as small intensely black squares. From this source is derived the magnetite in the black sand so well known to tin miners. On the whole the older lavas contain more felspar than the newer, the latter containing more olivine. The olivine can often be distinguished in the basalts, without the aid of the microscope, as minute glassy grains of light green colour. The basalts at Reynolds' Selection, the Pipeclay Gully, Kangaroo Flat, and Surface Hill, have an opaque black base, which may be due to their having been cooled suddenly, perhaps under water. At the Wellington Vale Lead there are two types of basalt, the older being more felspathic than the newer. Two varieties of basalt depart slightly from the characteristic local type. One may be noticed at the "Spring's Lead" at south-east corner of portion 74, parish of Athol, a dense rock porphyritic by augite, the black crystals of augite ($\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter) weathering out from the surface of their reddish or greenish-brown base. The other variety occurs near portion 172, south end of parish of Arvid, and is distinguished by its richness in titaniferous iron and magnetite. The surface of the ground here, after rain, is strewn with shiny black sand like broken bottle glass, much resembling tin-stone, but consisting chiefly of titaniferous iron, derived from the wearing down of this rock. In degrees of crystallization the lavas show every gradation from a coarsely crystalline dolerite to a stone nearly passing into tachylyte or basalt glass. The most coarsely crystalline varieties noticed by me were in the Spring's Lead, near the south-east end of the parish of Athol, where the constituent minerals could readily be distinguished without the aid of a pocket lens. The most finely crystalline varieties have so much glassy material in their composition as to closely approach the rather rare rock tachylyte or basalt glass; but in this case crystals of felspar and olivine are so plentifully scattered through the transparent yellowish-brown base as to preclude the application to it of the term tachylyte in its strict sense. Fragments of this rock may be picked up on the basalt near the east side of portion 70, parish of Arvid, where it is spread over the hill-slope as pebbles or lapilli about the size of walnuts, of irregular shape with honeycombed surfaces. The stone, where it has been freshly broken, is very black, having a dull lustre.

Laterite—locally termed "red clinker" and "ashes." This formation has a superficial area of 11 square miles 577 acres, and a thickness of from a few feet to 40 feet. These beds consist at the surface of a red dusty soil passing downwards into red, yellow, or grey tuffs and compact pisolitic ironstone, which in their turn graduate into rotten spongy basalt. The prevailing colour is from a bright to dull brick red, due to the presence of peroxide of iron. Magnetic iron is also present in sufficient quantity to deflect the magnetic needle. Viewed in its broad masses the laterite is found to be most largely developed near the highest points of the sheets of lava, and, as will presently be shown, near the scene of their eruption, as at the sources of the Graveyard and Vegetable Creek Leads, in the parish of Astley, at the head of the Spring's Lead, and in the parish of Lorne, near the sources of the Ruby Hill and Rocky Creek Leads. As specimens of this rock taken from different localities vary considerably in structure and composition, the term laterite must be understood to have a rather wide application. While some of the specimens are clearly tuffs, others show little traces of eruptive origin, and may be described as earthy pisolitic ironstone, more allied to a sedimentary formation than to a volcanic.

The worked areas, near the upper ends of the Vegetable Creek and Graveyard Leads, offer the best facilities for studying its nature, the rock here having been pierced by numbers of shafts. The low conical hills, and hard red hills, forming the main water-parting, are mostly composed of laterite. As the country falls away from these hills the tuff thins out, and the stony lava appears. In portion 724, Strathbogie North, the laterite forms the rim and bottom of a semi-circular basin, 6 chains in diameter, from the centre of which a miniature stream of stony basalt takes its rise. This is evidently an extinct crater. In the Wesley ground, in portion 40, Hamilton, are four low conical hills, each of which is composed of red or yellowish-red earthy laterite, the tuffaceous character of the formation being more apparent here than elsewhere. Balls of rotten pink lava half an inch in diameter are bedded in an ochreish earth, like plums in a pudding. Sharp, doubly terminated quartz crystals, with bruised edges, and splinters of quartz, as sharp as broken glass, are scattered plentifully through the mass of the tuff, the whole having been derived from the grinding up of the underlying quartz-porphyry during volcanic eruptions. In the parish of Astley the laterite and tuff hold a similar place with respect to the stony lava, occurring at the head of the lead in low conical hills with slight depressions at their summit, or in long ridges of hard scummy ironstone. In the parish of Lorne the laterite has built up the highest ridges of the "Gap" forming the rim of an old crater. Whenever the laterite and hard lava occur together the former almost always overlies the latter, though in portions 72 and 135, parish of Arvid, and at the head of the Wellington Vale Lead near portion 534, Annandale, the tuff is interstratified with the sheets of stony lava. A feature, not insignificant as to the origin of this formation, is the occurrence in two places of cavernous spaces separating the under surface of the laterite from the upper surface of the underlying basalt. One of these caverns was met with by Mr. H. Jew in sinking his 220 feet shaft in Reynolds' selection in portion 512, parish of Scone, near Emmaville. When sinking through the hard laterite Mr. Jew found the ground sound hollow, and, as the sinking continued he broke into a natural cavern at 30 feet from the surface, the base of the laterite being separated from the underlying surface of rotten lava by a space of 2½ feet. The floor of this hollow was strewn with small round concretions of brown iron ore which had fallen out of the laterite from the roof. The cave extended on all sides as far as Mr. Jew could see, but was not explored for any distance away from the shaft. This hollow is now concealed by wooden slabbing. A similar cavern exists in portion 1, parish of Arvid, where the volcanic tuff, 5 to 6 feet in thickness, forms the spring of a low arch from 2 to 3 feet high and about 15 yards wide. The cave has been laid bare through the partial collapse of its roof. These caves have probably been formed by the lava sinking from under the tuff-beds, which may have been close to points of eruption, so that the lava would have a tendency to be forced to a higher level here than elsewhere; and so, as the eruption subsided, would, like water, seek to find its own level, and thus leave a hollow between its surface and the harder crust of overlying tuff. Darwin in his "Geological Observations" (second edition, page 116) describes similar hollows at the bases of small basaltic craters at Chatham Island, in the Galapagos Archipelago, where he observed several "nearly circular pits with perpendicular sides from 20 to 40 feet deep," formed, he thinks, by the falling in of the roofs of small caverns, produced by the expansion of gases in the lava which had heaved its surface into huge bubbles or blisters. The caverns in the Emmaville basalts may have had a similar origin and have been due rather to the distension of the surface of the scummy lava, by imprisoned gases, than to the subsidence of the fluid lava from an over-lying cooled crust or tuff.

Sources of the basalts and laterite.—In many parts of New South Wales streams of basaltic lava have welled up from wide fissures in the older rock. Such cracks filled with lava are known under the name of dykes, as, where the casing rocks are softer than the lava, the latter stands out above the level of the country like a wall. Dykes of this description may be studied, at intervals, in the fine cliff sections near Sydney, from Bondi to La Perouse; the first example being close to the point where the new sewer will discharge into the ocean at Bondi. At Inverell similar basalt dykes traverse the claystone rocks.

In the Vegetable Creek district, however, I have been unable to discover a single dyke of true basalt, so that if any such exist they must be concealed under the basaltic country. The diorite dykes near Strathbogie, Hall's Sugarloaf, and the Spring's sheep station, Rocky Creek, may possibly be connected with the basalt streams, but, as yet, I have not been able to find any olivine in them, a mineral of universal distribution in the local basalts. The source of a stream of lava, like that of a river, usually lies somewhere near its highest point; and an examination of the highest points of the basaltic flows leads to the conclusion that the lava has issued from hills belonging to two distinct types which may for convenience be termed scoria-and-dust cones and lava cones, the former being red and cindery while the latter are dark and stony.

(*a*) The first have already been described, under the head of Physical Geography, as forming the red scrubby country along the main line of waterparting and belong chiefly to the laterite formation. The Red Hills as shown on the map are divided into three groups:—

1. The Vegetable Creek and Graveyard group.
2. The group in the parish of Astley.
3. The group in the parish of Lorne, of which "The Gap" forms the centre.

The first is formed of hills and ridges of decomposed scoriaceous red lava and dust, so worn down that they form only slight prominences rising from 10 to 20 feet above the general level of the surrounding volcanic country, which is consequently rather featureless. In the parish of Astley the red country seems to have suffered less from subaerial waste, and the features are therefore more pronounced. Red hills with sharp outlines rise to a height of about 50 feet above the general level of the rest of the volcanic rocks; some are conical and flat-topped, while others are semi-circular and have a central depression, causing them to look like semi-craters. In the third group the features are still more marked and can be studied best in a hill called "The Gap." The Gap Hill forms the north-east end of a high ridge of laterite and scummy basalt, in the parish of Lorne. The summit is 400 feet above the general level of the lava sheets which radiate from it; and 200 feet above the general level of the neighbouring palœozoic rocks. Ascending "The Gap" from the north the observer passes off the stony lava on to the red dust and scoria at a level of about 2,125 feet above the sea. At a level of 2,310 feet a round stopper of stony lava is seen in the midst of the red country, and partly encircled by low walls of laterite. From here to the summit the slope steepens to an angle of 20° to 30°, and the rock becomes harder and more slaggy. The top is covered with scrub from 6 to 7 feet high, rendering it difficult for the observer to get a good view of the general shape of the hill. The latter, however, may be gathered from the geological map, which shows the hill to be conical, the edges of the hill top being elevated above its centre, so as to enclose a hollow, the bottom of which is about 40 feet below the level of the rim. The basin or crater so enclosed is a quarter of a mile in diameter. To the south-east the crater ring has been broken down, probably during a volcanic outburst; and the breach has been further deepened by the Forest Creek which has its source within the crater; a small natural section is thus afforded of the internal structure of the hill. In the banks of the creek hard masses of spongy laterite, 3 to 4 feet in diameter, are seen to overlie a soft purple lava which here forms a central core in the bottom of the crater. Following the creek down, the observer passes gradually below the level of the soft lava on to a small stream of hard stony basalt, which has evidently welled up from some point beneath the crater. The hill, therefore, possesses all the essential features of a volcanic crater, and may consequently be considered an extinct volcano. The nature of the laterite ridges immediately to the south is more obscure; their outlines do not suggest the appearance of craters or fragments of such, though eruptions of lava seem to have occurred at intervals along their line. The eastern face is steep and scoriaceous, having an inclination of from 20° to 30°; the western has a very gradual slope. The ridge is from one to two chains in width at the summit, and runs south from the north-west corner of portion 37, parish of Lorne, for ½ a mile; then south-east for another ½ a mile. The present trend of these ridges may correspond with that of some underground fissure from which the lava has boiled up evenly, so that no regular craters have been formed except at points along the line where the volcanic energy became centralized as at the "Gap"; or this long-backed uneven ridge may have been the result of the progressive shifting of the volcanic orifice along a line of fissure. The above description is applicable to the red hills in Astley, and those near Emmaville, where a similar transition may be observed from the sheets of stony lava near the base of the cones or ridges to the red dust on their flanks, passing upwards into red, loosely-sticking pisolitic ironstone and compact scoria. In the two last-mentioned groups the volcanoes are smaller, and have suffered more from denudation than "The Gap."

Erupted Blocks.—Angular fragments of quartz-porphyry and granite about 1 foot in diameter, were noticed by me at different points near the edges of these extinct craters, on the Springs, Vegetable Creek, and Graveyard Leads. A careful examination of one of these fragments found on the slope of red hill in portion 234, Strathbogie North, led me to the conclusion that it had been ejected, as it was composed of a variety of granite unlike any to be found in the surface rocks of the neighbourhood, but identical with that in the "spoil banks" of a shaft sunk through this red hill on to the underlying granite. In portion 11, parish of Lockerby, county Arrawatta, are blocks of very coarsely crystalline basalt, resting on a tolerably even surface of finely crystalline lava of similar composition. These as well as other fragments occuring under similar circumstances, are all probably erupted blocks.

The most conspicious points of eruption belonging to the first class are:—

In portion 234, Strathbogie North.
„ 727, „ „ south-east corner.
„ 723, „ „
„ 41, Hamilton, south-west corner.
„ 42, „ north-west and south-west corners.
„ 47, „ south-west corner.
„ 699, Scone.
„ 1, Astley, on west line.
„ 5, „ near south-west corner.
„ 9, Astley, towards south end and north-east corner.
„ 11, „ „ centre.
„ 2, „ east of centre.

In portion 32, Lorne, north-east corner.
„ 37, „ north-west and south-west corners.
„ 30, „ south-east corner, 14 chains east of north-east corner.
„ 29, „ near centre.

The first type of points of eruption may be summarised as composite cones of red scoria and dust, more or less conical, from 50 to 400 feet high, the diameter at the summit varying from 60 yards to ¼ mile, and the angle of the external slope from 20° to 30°. A crater is sometimes present, but the majority of the hills have flat tops.

The second type may be described as lava cones terminating at the summit in a small slightly convex platform, rising from 150 to 200 feet above the general level of the lava streams which emanate from these hills. The angle of the outer slope does not exceed 20°. The localities where these cones are principally developed, have been already described.

The lava hills, constituting points of eruption of the second type, are less numerous than those of the first, and are divided topographically into two groups. The first lies in the parish of Arvid, in portion 134, and near the east line of portion 71; the second at the north-east end of the parish of Wellington Vale. In form, these hills differ from those of the first type in having sides whose slopes rarely exceed an angle of 20°, and in being destitute of a circular depression at their summits. The average height of these hills, above that of the surrounding lava, is from 150 to 200 feet. At Mount Prospect the basalt swells up into a ridge over ½ a mile long, with four hard flat knobs. [*See* section No. 8. P to R, and S to T.] These knobs are round or oval, slightly convex, platforms of basalt, from 70 to 80 yards in diameter.

Three lava cones occur in portions 600 and 534, parish of Annandale, and portion 523, Wellington Vale, respectively. The central cone, the largest of the three, rises to an elevation of 150 feet above that of the lava sheet at its base. The hill has a circular top, 80 yards in diameter, nearly flat, with a gentle rise towards the centre. The rock of which it is formed is a very dense dark bluish grey basalt, breaking into flags from 2 to 4 inches thick. The surface of the lava here is pitted with large steam holes up to 1½ inch in diameter, and in places has a streaked appearance owing to the weathering out of lines of fluxion, which at the north-east end of the cone dip north-east at from 30° to 40°. The angle of slope of the sides of the cone is however much smaller, not exceeding an angle of 20°. This is the highest point reached by the basalt in the whole district, being 3,650 feet above sea-level, as measured by aneroid.

In portion 1, parish of Hamilton, are four crescent-shaped or oblong projections, possibly marking points of eruption, rising a few feet above the surface of the lava stream. These are very dense towards their centres, and vesicular at the margins; and suggest the idea of their being hardened plugs of lava perhaps extending downwards into volcanic pipes.

Distribution of these Points of Eruption.—The geological map shows that these centres of volcanic outburst have a tendency to range themselves in certain definite lines. Near Emmaville, lines drawn through the principal points of eruption run west 25° north, and east 25° south, or north-east and south-west. In the parish of Arvid their trend is north 6° west. In the parish of Astley the conical hills do not show any definite arrangement, unless perhaps in a direction about west 35° north, and east 35° south. Near the Gap Hill, in the parish of Lorne, the old craters seem to be grouped in lines running west 30° to 35° north, and perhaps north 30° east. At Wellington Vale the general trend of the lava cones is west 35° north, and that of the lava plugs in portion 1, Hamilton, is north 30° west.

Metamorphic Action of the Basalt.—The streams of molten lava above described have by their heat, pressure, &c., produced certain mechanical and chemical changes on the mineral and organic substances with which they have come in contact. Where the basalt has flowed over a surface of dark blue claystone, the rock may be observed to be bleached for a short distance below the line of contact, as may be noticed at Hart & Swyny's tunnel at the Red Hill, near Emmaville.

The chief changes have been effected where the lava currents swept over soft beds of clay, sand, and gravel. In a shaft sunk by the Vegetable Creek Tin-mining Company, in portion 724, Strathbogie North, a sheet of basalt, over 70 feet thick, was found to rest immediately on a surface of pipeclay. For a distance of 1 foot below the point of contact the pipeclay had been rendered prismatic by the lava and blackened. The prisms, which were vertical and often hexagonal, were very slender, being from ½ to 1 inch in diameter. In Hume's shaft in the Wesley ground [*see* section No 1] the fine sand where it meets the basalt has been converted into a compact stone. The same change is observable at most places where sections showing the lines of junction can be obtained at Emmaville or Kangaroo Flat. The baking of claystone pebbles in tin gravel capped by basalt is well illustrated at Hall's Sugarloaf, at Kangaroo Flat. These pebbles, originally of a bluish or greenish-brown colour, have been thoroughly bleached by the basalt, and many of them baked into a hard red brick. Some of the pebbles have been so smoothed, polished, and striated by the passage over them of the lava as to closely resemble stones in the moraine of a glacier. The whole mass of the tin gravel at this spot is so compact that it has to be stamped by means of a battery before the tin ore can be extracted.

Silification is another change connected with the volcanic outbursts. The hydrous silica in solution in the basalt streams has filtered into and replaced the woody tissue of trees, &c., with which the lava came in contact, and converted them into wood-opal. Large fragments of wood opalized in this manner have been found at Kangaroo Flat, near the north-east corner of portion 64, parish of Arvid; at Surface Hill, in the parish of Flagstone, &c.

Palla is a term that has been applied to a red sinter, associated with the basalt. The rock is most abundant on the north slope of a basaltic hill in portion 26, parish of Hawthorne, county of Arrawatta, where it is found in rough red lumps, like caked mud, ½ to 1 foot in diameter. The palla here seems to have been the last product of the volcanic energy, deposited, most probably, from a hot spring or geyser. A specimen of a similar rock has been shown to me by Mr. H. S. Cox, Associate R.S.M., F.C.S., &c., from the Gawler Downs, Canterbury, New Zealand, where it lies on the surface of the outer slope of an extinct crater of cretaceous age.

Sedimentary.—The older tertiary sedimentary formations consist of:—

1. Beds of white, grey, and black clays, and silts.
2. Coarse well-worn sand and gravel.

As this formation is for the most part hidden under sheets of lava, only an approximate estimate can be formed of their underground area. Their superficial area is 1 square mile—460 acres, and the length of leads, as already stated, is about 49½ miles. In places, however, as has been proved, two channels must underly the basaltic country.

Doubling the lengths of the gravels, where such second runs are known to exist, the total length of the beds would be raised to 74 miles. This estimate is made on the assumption that the gravel beds are continuous throughout the whole of the "deep lead" area. Plans of the underground workings however of the Vegetable Creek and Wesley Tin-mining Company, show that these gravels occur in patches which are often separated from one another by stretches of bare rock—a phenomenon common in the channels of the local rivers. The sedimentary beds are most extensively developed near the sources of the leads and of the lava sheets. At the upper end of the Vegetable Creek and Graveyard Leads the width of the gravel beds varies from 10 to over 300 feet, and the sand and clay beds, where they attain their greatest known breadth, are ½ mile across. At the lower end of the Vegetable Creek Lead, at the Fishing Grounds, the smallest estimate of the width of the gravels may be taken as 200 yards; and at Kangaroo Flat, at Cockatoo, Rocky Creek, and Ruby Hill, about 80 yards. The thickness of the "deep lead" sedimentary beds varies from a few feet to 79 feet. The beds attain this last-named maximum thickness at Hart, Flannery & Company's "Hard Rock Shaft" in portion 2, parish of Hamilton. Near Emmaville, the average thickness of these beds is 25 feet; at Kangaroo Flat they are 1½ feet; at the Avoca Mine, 12 feet; at the Surprise Mines, 8 feet (though here in places the shingle reaches a thickness of 25 feet); at Rocky Creek, 10 feet; and at Ruby Hill, 12 feet. Little is known of the deep lead alluvial deposits on the Wellington Vale Lead, beyond that, at Bates' 116 feet shaft, they are 25 feet thick.

The average width of these beds is approximately 50 yards, and their average thickness about 20 feet; that of the coarse gravels being 4 feet. The clays in places, *e.g.*, at Rose Valley, at Witherden's tunnel, at the Two-mile, near Emmaville, and at Bates' shaft, in the parish of Wellington Vale, contain great numbers of leaves belonging to species of plants, most of which have now become extinct in Australia. This palæophytological evidence suffices to distinguish these strata, and the beds of sand and gravel with which they are interstratified from the pliocene formations. Where fossils have not been found, the rocks have been classed on stratigraphical and lithological evidence. Estimated by a comparison of the level of these gravels with that of those now forming along the banks of streams, the time which has elapsed since the deposition of the oldest of these gravels must be very vast. The principal physical difference between the older tertiary gravels and the post-pliocene is that the former are very much water-worn as compared with the latter.

This characteristic is specially marked with regard to the quartz pebbles, which are angular or subangular in the post-pliocene gravels, but always rounded in the older tertiary. In lithological composition the older tertiary gravels differ from the newer tertiary and post-pliocene :—

1. In being almost wholly composed of quartz pebbles.
2. In containing a large admixture of gem stones, as zircon, topaz, beryl, garnet, emerald, sapphire, &c.

These last characteristics are most pronounced in the oldest gravels of the group, while the younger members contain a considerable proportion of pebbles, of claystone, quartz-porphyry, granite, &c.

At the Surprise Mines in the north-east end of the parish of Athol, extensive denudation has revealed good sections of three terraces of coarse tin gravel at different levels. [*See* Section No. 6, K—L.] The lowest of these terraces evidently belongs to a far later date than the highest, and probably should be placed among the newest members of the series. The gravel in the lowest terrace occurs in two outliers capped by basalt, having an area of about 40 acres, and a thickness of from 4 to 6 feet. The shingle and gravel consist of large smooth blocks and round pebbles of argillite, quartz-porphyry, felspathic quartzite, and clean white quartz sand. At intervals lenticular beds of fine quartz sand are met with, and carbonized plant remains have been discovered in the surface of these beds at their point of contact with the basalt. The great pressure of the superincumbent lava (100 feet thick) has squeezed these beds into a loose conglomerate which has become further consolidated by a natural cement of hydrous brown iron ore.

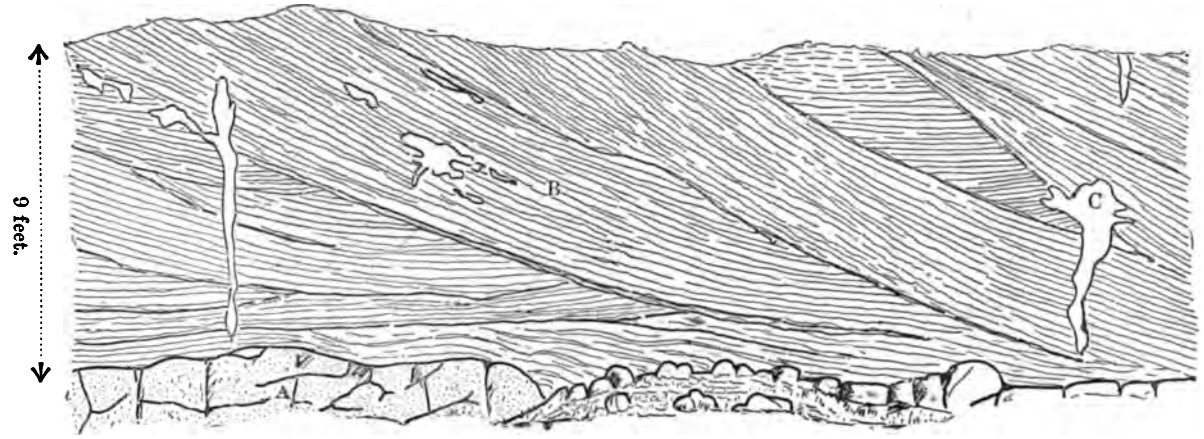
Similar coarse gravels occur at the Fishing Grounds, and the Avoca Mine, Kangaroo Flat, and at Cockatoo, 2 miles north-west of the Surprise Mines. The quartz, which occurs chiefly in coarse round grains, is of a prevailing dark colour. Stream tin is distributed through the mass of these beds, but barely in payable quantity. Gem stones are most abundant where the gravel shows evidence of having been derived from the waste of coarse granite.

In the middle terrace the shingle is over 25 feet in thickness, and the level of the base of the bed is 230 feet above that of the lowest gravel bed. The blocks of stone here are more decomposed than those in the lowest terrace. Separated from this middle terrace by a narrow belt of quartz-porphyry is the highest terrace of shingle, from 2 to 16 feet thick. The shingle is composed of well-rolled pebbles of argillite and felspathic quartzite, and very rotten subangular blocks of quartz porphyry, some 3 feet in diameter. Patches of clean quartz sand, and lenticular beds of pipeclay containing fossil leaves, are found in the upper part of the beds, the base of which is about 10 feet above that of the middle terrace. The nearest present stream capable of producing such a coarse worn shingle, is the Glen Creek or Beardy, the nearest point of which lies to the north, 1 mile distant, the level of the bottom of its channel being over 600 feet below that of the lowest gravel terrace.

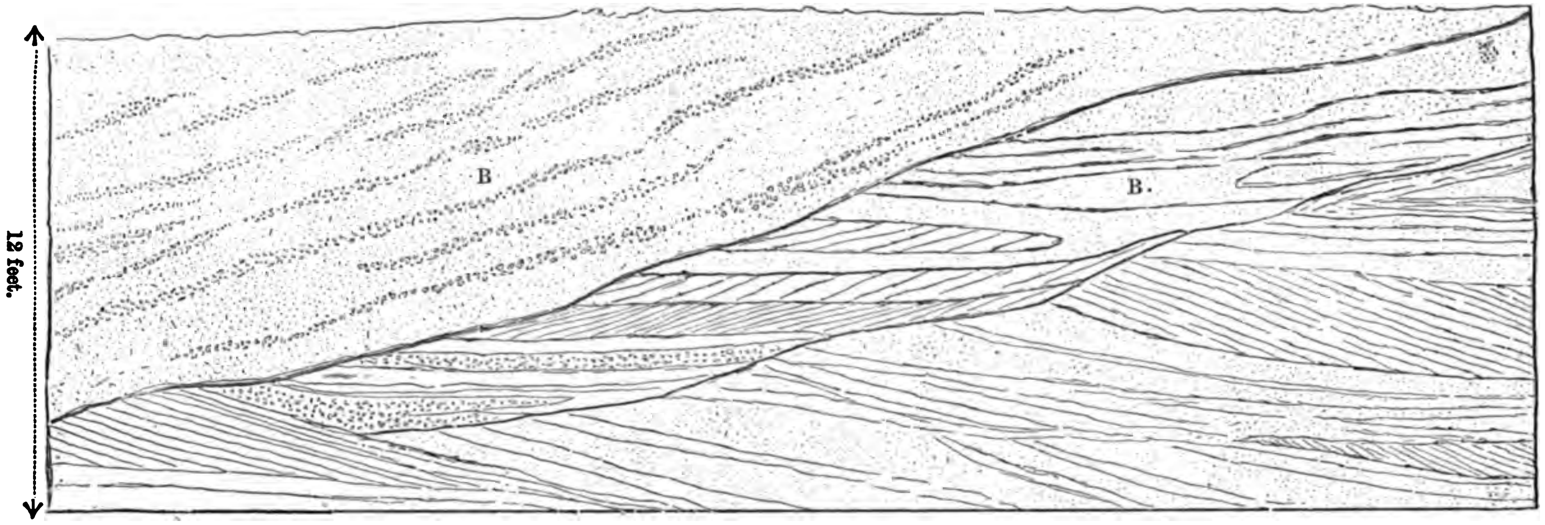
The gravels in the first and second terraces are far richer in stream tin than those in the third. At the Y. Water Holes, near Emmaville, the general character of the older tertiary beds, and their relation to the volcanic rocks, is well shown in the various shafts and excavations.

Their total superficial area is 1 square mile 449 acres, and their thickness varies from a few feet to 60 feet. The beds here are composed of coarse red sands and yellowish green clays, and quartz-porphyry at the base of the beds, with pebbles of granite. The sands are red rock sands, with lenticular beds of clay; the grains of quartz being well rounded, and some having a high polish. These tin sands are loosely cemented by peroxide of iron, which lends the red colour to the beds. When quarried the sand can be brought away in large flakes by the pick, and can be undermined considerably before it caves. Towards the base of the beds the sands are generally looser, being freer from iron cement, and consequently need to be kept from falling in, in the shafts, by wooden slabs. Fine examples of current or diagonal bedding may be seen at the open quarries at the Y. Water Holes. Near the surface irregular-shaped cylindrical patches of bleached sand may be noticed in places where the iron has been dissolved out of the sands by roots of trees. [*See* Fig. 1.]

FIG. 1.



A.—Metamorphic granite. B.—Current-bedded red stanniferous sands. C.—Patches of white sand.



The amount of dip of some of the current bedding is as high as 35°, but this excessive dip is very local, extending for a few feet only. The general dip of the diagonal layers is south 10° west, at from 10° to 25°. Followed in an easterly direction, this formation thickens, and its lithological character changes slightly. At Davidson and Kirker's shafts [*see* section No. 3] the clay at the surface is stained red, probably by a decomposed basalt, for at David Lewis's shaft, a little lower down the lead, decomposed basalt was met with in the first 5 feet of the shaft. As the thickness of the beds increases, so the sands at their base become cleaner and the clay whiter, so as to form a pure white pipeclay. In Kirker's 47-foot shaft, in portion 63, parish of Scone, the diagonal bedding of the sands dips sharply to the south-west, showing that the currents which deposited them and the stream tin set from the north-east. At the Graveyard workings, in portions 197 and 201, Scone, the red sands and pipeclays are covered by laterite to a depth of 36 feet. From here their extension westerly is masked by this volcanic formation, but at Hurley's shaft, 124 feet deep, in portion 523, Scone, similar red sands were passed through in the shaft, and extend downwards from the surface for 46 feet, at which point they rest on a floor of hard dark green lava. The fine white sands, 8 feet thick, said to have been passed through in sinking a deep shaft still further west, in Kennedy's paddock, portion 516, Scone, at about 80 feet from the surface, may belong to the same formation. That these red sands probably underlie a considerable area of the laterite is proved by their lines of outcrop running to the north and south of the laterite for two miles west of the old Graveyard workings. The northern outcrop of the red sands is lost in the middle of Kennedy's paddock. From here they can be traced as a thin surface deposit for three-quarters of a mile north-easterly towards Emmaville; at this point they are concealed by the volcanic country but outcrop again near the south-east corner of portion 728, Strathbogie North, and can be followed from here round the boundary line of the laterite into portion 235, Strathbogie North, where they pass gradually under the recent "cement." A narrow belt of similar red tin gravel has been worked in the Great Britain Company's Mine, in portions 540 and 912, Strathbogie North; and another narrow strip in Bailey's shallow lead in portion 20, Hamilton. An outlier of red tin sand, like that at the Y. Water Holes, has been mined in a small patch capped by hard lava in portion 143, Arvid; but there is not sufficient evidence for asserting that these beds are of the same age. As the beds pass from the Y. Water Holes to the Graveyard, the coarse irregularly shaped quartz grains, forming the sands derived from the granite, give place to fine doubly terminated quartz crystals which have been washed out of the quartz porphyries; and the flakes of mica, so common in the Y. Water Holes' pipeclay, become less frequent in that at the Graveyard. In fact the formation varies with that of the underlying rocks, and the proportion of clay to sand changes from three-eighths clay to five-eighths sand at the Y. Water Holes, to one-half clay and one-half sand at the Graveyard. The thickening of the clay beds westwards is shown on sections 3 and 4. The dip of the clay beds at the Graveyard is also westerly. The tertiary sand and clays are separated from the underlying hard rock in places by patches of gravel, composed of water-worn pebbles chiefly of quartz porphyry, containing the stream tin, and varying in thickness from a few inches to 2 feet. These pebbles, which are rarely found in the Y. Water Holes' sands, increase in number towards the Graveyard, where they are frequently from 3 to 6 inches in diameter. At Francis' shafts, in portion 195, Scone, fossil leaves were found in the pipeclay, but elsewhere this formation has proved barren of organic remains. The sides of these beds merge into the recent and pliocene alluvials. The worn nature of their sand grains, and the fact of their being capped by the volcanic rocks, marks them off as belonging to the tertiary volcanic period; while the section at Hurley's shaft above referred to, shows that they overlie the hard lava, and so are interstratified with the volcanic rocks. Where the separating wedge of lava is absent no line can be drawn to divide these beds from the gravels underlying the stony basalt. For the relation of these sedimentary beds to the volcanic, see sections Nos. 3 and 4.

The red sands and gravels of the Y. Water Holes, Graveyard, and Vegetable Creek Leads, as they dip under the hard lava, lose their red colour, but otherwise undergo no appreciable change. A typical section of these beds is given in Fig. 5, across Flannery's Lead, in the old Wesley Mine. These gravels composed of water-worn blocks of euritic quartz-porphyry, and well-rolled quartz pebbles, lie in a distinct channel worn through the bed rock, and belong to the same run of gravel which, at Rose Valley, near Emmaville underlies leaf-beds of early tertiary age.

The oldest tertiary gravels in the district are probably those forming the two small outliers at "Scrubby Gully" and "Surface Hill." At "Scrubby Gully" this gravel occurs in a bare patch having a superficial extent of 11 acres and a thickness of from 2 to 14 feet, the average depth being 3 feet.

The beds are composed of fine clear yellow quartz sand, not much waterworn, with well-rolled quartz pebbles, pale blue topazes, beryls, and stream tin; the whole being protected by a crust of felspathic cement similar to that described at Emmaville. The tertiary gravels at Surface Hill form three outliers. At Surface Hill a flat-topped ridge of claystone is capped by a bare oval patch of tertiary gravel. The deposit has an extent of 1 acre and a thickness of from 1 to 2 feet. The pebbles of which it is composed are principally quartz, from 1 to 6 inches in diameter, and as smooth as eggs. A great deal of tourmaline, as well as topazes, beryls, emeralds, and stream tin, are mixed through these gravels, which from their higher position appear to be older than the similar gravels underlying two neighbouring outliers of basalt. In its lithological character, and its stratigraphical relation to the "deep leads" this small outlier of gravel closely resembles the tertiary pebble beds at Cope Hardinge, near Tingha. The importance of these outliers rests not so much on the minerals contained in them, though that has been considerable, as on what they teach of the former wide distribution of stream tin deposits in early tertiary times. The gravels at Scrubby Gully and Surface Hill are over 6 miles distant from one another, the former being 3,360 feet above the sea level, and the latter 2,460 feet; while those in the Ruby Hill outlier have an altitude of 1,885 feet, and are over 25 miles distant from Scrubby Gully.

Quartzite and **Sinter,** locally called "Grey Billy," has an extent of about 40 acres, and a thickness of from 1 to 5 feet. The rock consists of waterworn sand grains and stream tin, firmly cemented into extremely tough stone by a milk white or pink chalcedony. From its distribution along the lines of junction of the basalt with the underlying and overlying gravels, there can be no doubt that it is intimately connected with the basalt, and was formed either at the time the basalts flowed, by the infiltration of superheated waters carrying silica in solution as they escaped from the lava, or from hot springs which would break out along the lines of volcanic fissures after the extravasation of the lavas had ceased. In some cases the rock may have been formed by the actual fusion of the quartz grains in the tertiary sands by contact with the hot lava, in which case the local term of "vitrified drift" is not inappropriate. It is also possible that these concretions in the gravel may have been formed by the segregation of silica in a manner analogous to that in which it is known to segregate in artificially prepared china clay. At Casley's workings, in portion 199 Scone, the "Grey Billy" takes the form of irregular-shaped lumps of hard rock, 2 to 3 feet in longest diameter. The current bedding of the surrounding loose drift sands can frequently be traced distinctly through the mass of the lump. Similar blocks occur in Fox's ground, portion 47, parish of Hamilton, and in portions 231 and 43, in the same parish, near Emmaville, and near Thomas's race, near portions 257 and 228, in the parish of Strathbogie North. The places where it is chiefly developed are in portions 59 and 225, parish of Scone; near the south-west corner of portion 693, Strathbogie; near the end of the south-easternmost flow of lava, in the parish of Astley, county Arrawatta; and near the north-east corner of portion 42, parish of Lockerby, in the same county.

A similar rock is described in A. G. Lock's work on gold, page 927, as an "intensely hard cherty silicious rock," occurring at Stony Creek, Newtown Hill, Victoria, under conditions precisely similar to those already described.

AGE UNKNOWN.

Diorite dykes are found cutting the upper Silurian claystones near Strathbogie, near Paddy's Sugarloaf and Hall's Sugarloaf, Kangaroo Flat, at the Springs' Sheep Station, and in the Wesley ground underlying the basaltic country. Their width varies from a few feet to 200 yards, and can be traced in places for over half a mile. The rock varies in chemical composition passing into porphyritic syenite and hornblendic granite. The strike of these dykes is north 10° west and south 10° east, and east 10° to 20° south and west 10° to 20° north. The rock is greenish-brown, showing decomposed opaque white felspar crystals, occasional grains of quartz and mica in a greenish-grey base, giving the rock a somewhat porphyritic structure.

Hypersthene - garnet---diorite has an area of between 400 and 500 acres, and forms a dark green to black hard rock, also occurring in dykes. These have a width of between 100 and 400 yards, and can be followed along the surface for from 2 to 3 miles. The three principal masses are found at Macdonald's tin veins, Hall's Grampians, and at Boiling Down Creek, near Tent Hill; the two last mentioned converge in the direction of the first and appear to have radiated from it. The composition of the rock is very variable, the principle constituent minerals being hornblende, felspar, probably labradorite, and hypersthene. In places the rock contains numbers of garnets and small patches of copper pyrites and zinc blende. A sample of this stone, assayed by Mr. J. W. Hall, managing partner of the Boorook Silver Mines, showed a trace of silver. The hardness is between 5 and 6; and the specific gravity 2·95. The dyke at Boiling Down Creek appears to have shut off an intrusive vein of granite, and so is probably of later age. The granite, as will be shown, is perhaps referable to the Permian period. An eruptive mass of chlorite and garnet rock, called Patterson's Reef, in portion 12, parish of Frazer, perhaps belongs to the same age as these dykes.

PALÆOZOIC.

Permian.—(*b*) A coarse grained intrusive granite, traversed by metalliferous veins, has an area of 287 square miles. This formation attains its greatest development in the Mole Tableland, where it forms an oval mass, measuring 25 miles by 14. The extreme east and west boundaries however, extend far beyond the limits of the geological map accompanying this report. The horizontal section No. 9 G–M shows this granite to be a broad, gently swelling mass of rock which has been squeezed up through the claystones, into which it has thrust numerous threadlike prolongations. The whole mass is divided into parallelograms by two systems of joints, the trend of which is evidenced by the courses of the creeks. The principal system of parallel joints runs north 30° east and south 30° west, while the cross joints trend about west 40° north. Besides the vertical joints there are other lines of division running horizontally through the granite, giving the rock as it weathers a rudely tabular appearance. Fine examples of "tors," due to the waste of the softer portions of the granite, were observed on the track between the tableland township and Black Swamp. In degree of crystallization this granite varies from a coarsely crystalline rock porphyritic by felspar crystals, 1 inch in largest diameter, to a rock in which the component minerals are so finely crystalline as to be scarcely distinguished without the aid of a lens. As a rule the granite is coarsely crystalline at a distance from the claystones, and more finely crystalline at its margin. Near Curnow's tin vein geodes of felspar and quartz are to be observed. An examination of the blue claystone, along the line of its junction with the granite, shows that the former is penetrated by thin veins of fine-grained reddish granite, offshoots of the main mass. The strike of these intrusive granite veins is east 20° to 30° north and east 10° south. The claystone rocks at the point of intrusion are slightly bleached and hardened, but do not exhibit marked signs of alteration.

Chemical Composition.—At least two varieties of granite are met with on the Mole Tableland :—

1. A coarsely crystalline ternary granite.
2. Euritic granite usually occurring in veins or dykes, as at Butler's and the Torrington Tin Vein.

1. The typical granite consists of quartz, felspar, mica, and hornblende. The felspar is monoclinic and triclinic, the former predominating slightly; the micas are muscovite and biotite. At the Torrington Tin Mine the granite is rich in biotite.

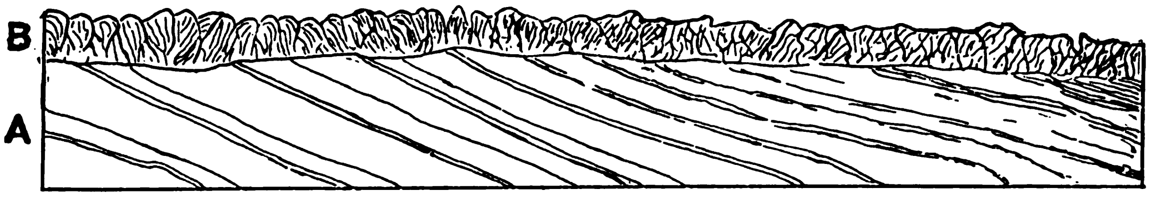
2. The eurite veins, which are from a few inches to a few feet in width, are composed of granular crystalline quartz and felspar with small flakes of mica, and are of later origin than the coarse granite. In portions 1 and 12, parish of Fraser, county Gough, a mass of garnet rock, measuring about 10 chains by 8 chains, occurs in the midst of very coarse-grained granite, and is associated with chlorite and hornblende. This is probably an eruptive mass to be correlated with the hypersthenite dykes. Quartz and chlorite are found in veins traversing the granite along the cleavage planes, or at an angle oblique to them. Such veins average 2 feet in width and contain fluor spar, tin-stone, arsenical pyrites, iron and magnetic pyrites, wolfram, bismuth, and molybdenite. A schorlaceous variety of granite has been worked for tinstone at Macdonald's veins on the Glen Creek. Schorl traverses this rock here in veins ½ to 1 inch thick, besides being disseminated through the mass of the stone.

Age.—The two types of granite on the Mole Tableland, although not exactly contemporaneous, have cut the upper Silurian claystones, as well as the porphyroid and porphyrite, and have been classed as Permian, because granite of a similar nature has intruded and altered sedimentary rocks of probable lower carboniferous age at Fraser's Creek, 18 miles to the west.

AGE UNKNOWN.

(*a.*) **Intrusive hornblendic granite.**—This rock is most largely developed at the Fishing Grounds, near Kangaroo Flat, and bears some resemblance to the metamorphic granite at the Y. Water Holes, near Emmaville. In places, the rock becoming poor in quartz and correspondingly richer in hornportion 1, parish of Hawthorne, where it forms an inlier in the tertiary volcanic country, 1 mile long and 4 chains wide. The surface of this tuff is rough and spongy, angular cavities being formed by the weathering out of soft fragments from the paste of hard lava in which they have been cemented. The colour of the rock is greenish-grey. What appears to be a true eruptive felstone was noticed by me near the north-west corner of portion 11, parish of Astley. A freshly broken surface of this rock revealed several thin sheets of felsite, ⅛ inch to 1 inch in thickness, separated by equally thin seams of volcanic dust. The felsite at this point is on the line of extinct basaltic craters. The nature of the quartz-porphyry and felstone dykes, and their relation to the Upper Silurian claystones, is shown on fig. 2.

FIG. 2.



A.—Shales and gritty sandstones.
B.—Quartz-porphyry.

(*a.*) **Intrusive and partly eruptive hornblendic quartz-felsites, felsitic breccias, and euritic granite.**—The boundaries of this rock not having been defined, their area has not been determined. The formation, however, has a distinct trend in a direction 27° north of west and south of east, and has been traced by me at intervals from Skeleton Creek, near Bald Nob, to the north-west corner of the parish of Lorne, a distance of over 50 miles. The greatest observed width of these greenish quartz-porphyries and felsitic breccias was 2 miles. In portion 12, Strathbogie, in the bed of Vegetable Creek, to the west of Emmaville, a laminated black quartz or chert is found in the midst of the quartz-porphyry, striking east 6° north, and the same rock reappears in portion 540, Strathbogie North, on the road from Emmaville to Tent Hill. A similar rock was noticed by me in portions 178 and 179, parish of Scone, apparently interstratified with the claystone. The breaking up of this rock has formed the "black quartz" so well known to Vegetable Creek miners, and always regarded as a favourable sign for tin ore. The greater part of the rock is cleaved in directions varying from east 30° north to east 20° south, and north 7° west. The average direction of the principal cleavage planes is east 8° north. In the neighbourhood of Emmaville the space between the cleavage planes has been filled in with minute seams of quartz and tinstone, averaging ¼ inch in thickness. Along the margins of the principal masses the rock is seen to be brecciated, as in portions 120 and 20, parish of Hamilton, and at the Gap Hill, near Emmaville. The enclosed fragments, from 1 to 2 inches in diameter, are claystone and angular pieces of felsite. At the north-west corner of the parish of Lorne, where Bough Yard Creek crosses the boundary of the parish, the rock has much the appearance of a volcanic breccia, the colour being greenish-grey, and the rock consisting of fragments of claystone (one over 4 feet in diameter), mixed with banded felsite, quartz grains in double-pointed pyramids, broken crystals of white felspar, and greenish earthy mineral. One specimen contained a well-rounded pebble of quartzite 1 inch in diameter. The more distinctly fluidal varieties of this rock vary in degree of crystallization from a coarse-grained white aplitic granite to a very fine-grained rock, with a fracture like that of hälleflinta, and resembling an altered rhyolite. Under the microscope the rock is seen to consist of a micro-crystalline base of quartz and felspar, with spicules of hornblende or mica and a little interstitial glassy material, biotite and chlorite being often present. The quartz crystals frequently contain stony enclosures. Specimens, taken from the north end of portion 117, parish of Scone, are full of little rounded concretions of a glassy mineral resembling quartz, often piled one upon another, so as to resemble the whorls of shells, and to suggest the idea of their being fossil univalves. Under the microscope, however, these are seen to be aggregates, probably of felsite material, showing an internal fibrous radial structure. Besides this felso-spherulitic structure the rock shows distinct lines of fluxion, as near portion $\frac{2}{4}$, Strathbogie; and the weathered surface of the stone suggests the presence of amygdaloidal cavities. Hornblende or chlorite, is very abundant in places, giving the rock a distinct greenish tinge, regarded by the miners as favourable to the occurrence of tin. In portion 146, Strathbogie North, and near portion $\frac{2}{4}$, Strathbogie, the hornblende occurs in radiated tufts or nests, ½ inch in diameter. The junction of the quartz-porphyry with the claystone is well shown near Emmaville, in the underground workings at Bailey's and the Wesley Mine. In the sections in the drives the line between the two rocks is very sharply defined, the quartz-porphyry along the margin being squeezed somewhat into the claystone and enclosing fragments of it, thereby showing distinct evidence of intrusion. The junction of this rock with the porphyroid and the porphyrite and the metamorphic granite is less clear. At the top of the Gap Hill, 1 mile south of Emmaville, a well-defined band of breccia is observable, which may perhaps mark the junction of the intrusive with the metamorphic rock. Thence the breccia beds run south-west through portions 193 and 191, parish of Scone, to 702, parish of Strathbogie; and in a north-westerly direction are found again at the junction of the grey felspar-porphyry with the porphyrite, at a point 1¼ mile south of portion 600, parish of Highland Home.

Porphyroid.—The line separating this variety of rock from the preceding is rather arbitrary, though perhaps marked by the breccia belt just described.

The occurrence of the ripple-marked chert in this formation in portion 187, parish of Scone, and between this point and the Tip Head, 4½ miles south south-west from Emmaville, interstratified with the porphyroids, show that here these rocks must be partly of metamorphic origin.

At the west end of portion 112, parish of Scone, there is an appearance of bedding in the crystalline rock as evidenced by alternating bands of felspar-porphyry and quartz-porphyry.

This inference as to the partial metamorphic origin for the porphyroid is strengthened by the fact, that at Rose Valley, near Emmaville, a bed of pebble-conglomerate may be traced striking through the mass of the quartz-porphyry, and yet so transmuted as not to be distinguishable from that rock in the field, except on well-weathered surfaces, which at once reveal the original clastic origin of the rock.

The pebble bed, which is from 1 to 2 chains wide, strikes from the middle of the north line of portion 230, Strathbogie North, south-westerly to the Graveyard Creek, in portion 180, Scone. At this point the rock almost entirely loses its crystalline condition and passes into the ordinary pebble-conglomerate so frequently associated with upper silurian strata.

That this rock is older than the tin granite is proved by the fact that at a point 1½ mile south of portion 300, parish of Highland Home, the porphyroid near the boundary of the granite is cut by intrusive veins of the latter. [For further accounts of a metamorphic conglomerate in New South Wales, similar to that described, see account by Mr. C. S. Wilkinson of that, near Parkes, &c.; by Mr. E. F. Pittman, Associate R.S.M., of that, at Hill End; Mineral Products of New South Wales, 1882, page 61.]

A foliated structure was observed in this rock near portion 160, parish of Scone. The strike of the folia of felspar and hornblende was 30° east of north and west of south. This is the only point in the district where such a structure was noticed.

PALÆOZOIC—(*continued*).

Upper Silurian (or Siluro-Devonian).—These strata consist of olive-green clay shales passing into dark blue and black claystones with bands of leaden-grey felspathic quartzite, and beds of greenish-brown conglomerate siliceous grit and quartzite. Area 34 square miles; thickness at least 5,000 feet.

By far the greater part of this formation is composed of beds of clay shale and claystone.

In the vicinity of the crystalline rocks the colour of the silurian strata is bluish-brown to indigo, but at a distance of 2 to 3 miles from the igneous rocks the colour changes to a greenish or rusty-brown.

The bands of felspathic-quartzite are from 3 to 4 inches in thickness, and occur at intervals of from 1 to 2 feet, the intervening rock being claystone.

In places, the clay shales are much blackened by carbonaceous matter, which is seen under the microscope to have become altered into graphite in places, and where the carbonaceous claystones have come in contact with igneous rocks, and become silicated, a hard lydian stone has been formed, as to the north of Bailey's Mine, in portion 20, parish of Hamilton.

In texture these rocks vary from a fine compact stone to pea-grits and coarse conglomerates.

The conglomerates are formed of well rolled pebbles of quartzite, claystone, and occasionally quartz, set in a base of felspathic-quartzite or sandy-clay shale. The size of the pebbles varies from ½ inch to 6 inches. The coarsest conglomerate noticed by me was on Stony Creek, in portion 180, parish of Scone.

The disintegration of these pebble-conglomerates gives rise to small surface accumulations of gravel, which in the neighbourhood of these conglomerates are apt to be mistaken by the miner for tertiary gravel. He should therefore be on his guard to distinguish these derived silurian pebbles from the true tertiary, as the former are not usually an indication of stream tin, whereas the latter generally are.

In the vicinity of the crystalline rocks nearly all traces of the original bedding in the claystones has been effaced, and the rock has been cleaved by a series of cross joints running 20° north of east and south of west, and 20° west of north and east of south, causing the stone, when disintegrated, to split up into angular cubical blocks.

In such altered areas indication of the original stratification is given in places by the beds of pebble-conglomerate and chert. The laminæ of the chert beds are very thin, over 100 being present in a thickness of 2 inches.

The average strike of these rocks is 35° east of north and west of south, and the prevailing dip appears to be westerly, but there is evidence of the beds having been folded over, so that the direction of the dip is frequently reversed.

The amount of dip varies from 17° to an angle of 90°, the average inclination from the horizontal being 50°. As a rule the dip is steeper as the claystones approach the crystalline rocks, and gentler as they recede from them.

Fossils were found by me in these rocks only at three places :—

1. Near the south-east corner of portion 7, parish of Arvid. The strata here are fine bluish-brown sandy claystones, in beds from 2 to 3 feet thick, separated by layers of bluish-black clay shale from 1 inch to 6 inches thick. The last show black stains, due to obscure plant remains.
2. In the bed of Stony Creek, in portion 30, parish of Arvid, a bed of compact grey quartzite shows faint impressions of bryozoa, and stems of stone lilies.
3. At a point about 50 chains west, 10° south from the north-west corner of portion 136, parish of Arvid, is a pale blue siliceous grit with rusty cavities showing casts of bryozoa, small lamellibranchs and univalves, and a few joints of stems of stone lilies. This fossiliferous bed is a few feet only in thickness. These fossils prove the beds to be of marine origin, but do not afford conclusive evidence as to their age.

The rock, as seen in thin slices under the microscope, is composed of crystals of triclinic felspar $\frac{1}{4}$ to $\frac{1}{2}$ inch long, crystals of hornblende, and small patches of epidote in a dark bluish-grey ground-mass. The hornblende crystals around their margins are decomposed into a yellowish-green mineral, probably epidote.

In portion 71, in the parish of Wellington Vale, the porphyrite is of a dark brownish-blue colour, weathering in rudely dome-shaped masses, dotted with rough knobs projecting $1\frac{1}{2}$ foot above the uniform surface, and breaking into lumps with rounded or sharp edges. The rock here is cleaved in a direction 30° east of north and west of south, and is traversed in a direction 5° north of west and south of east, by slender veins of quartz and epidote $\frac{1}{8}$ inch to 1 inch thick.

Near the Planet Mine, in portion 121, parish of Wellington Vale, the rock, as seen under the microscope, in structure resembles basalt, and may be an old dacite or diabase, the olivine being replaced by epidote. Although, therefore, the rock in part may be a true lava, extruded at the surface, it would be useless to search under it for stream tin, the tin granites being of later age, as is shown in Fig. 3.

The transition from the porphyrite into the metamorphic granite, rich in hornblende and dark mica, is very gradual, and in places there seems to be an insensible upward passage from the porphyrite through the grey porphyroid into the claystone. In this process of alteration the first mineral to separate out from the claystone appears to have been the felspar, next the quartz, and lastly the mica and hornblende. This transition is well seen between Deepwater and Dundee.

Metamorphic Granite.—This rock, which, as far as shown on the geological map, has an area of 62 square miles, is seen under the microscope to be crystalline granular, and to consist of triclinic felspar, quartz, biotite, and hornblende, the last mineral being partly altered into epidote.

No metalliferous veins nor dykes have been observed in this formation.

In one spot, however, a small bunch of copper pyrites and blende 1 inch in diameter was noticed. The alteration of this rock dates probably from a period intermediate between the deposition of the Silurian rocks and the intrusion of the tin granite.

west and south of east, and 33° north of east and south of west, the granite being cleaved 31° east of north and west of south, and 40° south of east and north of west, and the quartz-felsites and claystone 20° north of east and south of west, and 20° west of north and east of south. Whether any of the quartz-felsite dykes reached the surface and poured forth flows of lava, is doubtful. Strong evidence is afforded by the beds of coarse volcanic agglomerate and volcanic breccia, and the glassy nature of some of the felsites, of the existence here of true acid lavas; but the date of their eruption has not been fixed further than that it was earlier than the tertiary, and not older than the Permian. [*See* "Mines and Minerals Statistics" of New South Wales, for the year 1875, page 80, Geological Surveyor C. S. Wilkinson's Report.]

Mr. Herbert S. Cox, F.G.S., F.C.S., &c., has lately suggested that part of the quartz-felsites near Emmaville belong to the epoch of volcanic activity in the early tertiary time which has produced the basalts. In this case the felsites must have been nearly contemporaneous with the basalts, and represent the earlier products of the eruptions. If they are true lavas erupted at the surface, it follows that before their flow the Silurian strata must have been subjected to extensive denudation, for the sheets of quartz-felsite rest horizontally or at low angles on the truncated edges of the upper Silurian claystones. In this case deposits of stream tin may be found under the quartz-felsites, if at any point in this stanniferous district they are found to overlie contemporaneously-formed gravels. This point might be settled by searching along the junction lines of the quartz-felsite and the claystone, for an outcrop of such a gravel, and if any can be found, the gravel or pebble conglomerate can then be tested for stream tin. The sections afforded by the Beardy River, near the infall of Swamp Oak Creek, offer great facilities for such an examination. At all events the elevation of the Silurian rocks and perhaps newer overlying strata, took place probably not later than the formation of the tin veins during the permian period. From the permian period, however, to the commencement of the tertiary era there is a vast gap in the geological record. The diorite and hypersthene dykes, and perhaps some of the felsites, and the metalliferous veins which have a north and south strike, are probably newer than the granite; but with the exception of these igneous formations the district has no representatives of the rocks of the mesozoic era. During the greater part of that vast period of time the surface of the land was being slowly broken up and worn down by the action of rain, frost, sunshine, vegetation, and perhaps marine erosion, until a land surface was by lava, was related to the present Beardy River. The bottom of the channel of the Beardy at the nearest point, 1 mile distant, is now 550 feet below the level of the bed of this buried river channel. The flora of the period, to judge from the number and variety of leaves entombed in the eocene pipeclays, was rich and diversified. The fossils are chiefly leaves of herbs, trees, and ferns, some having fruit, and one a blossom delicately preserved. At Rose Valley, near Emmaville, the vegetable matter has almost entirely disappeared, the cast only remaining in the white pipeclay, which is stained a rusty yellow where it has received the impressions of the fossils. At Witherden's tunnel, in portion 50, parish of Hamilton, the fossils are enclosed in a dark brown fine sandy clay, the original material of the leaf being preserved ; and at the head of the Wellington Vale Lead, leaves are similarly preserved in a hardened black silt. A collection of the fossil plants from Rose Valley has been sent to Baron von Ettingshausen, and as already stated, they are considered by him to contain many types found in the early tertiary flora of Europe and America ; thus establishing the age of the oldest leads near Emmaville as early tertiary. Amongst them are several varieties of beech and oak, pines allied to the kauri pine, and Wellingtonian pine, intermixed with banksias, grevilleas, laurels, and eucalyptus. A detailed list and description is given in Baron Ettingshausen's work now published. Impressions of fossil insects have been found on the Red Hill, near Emmaville, the markings being plainly visible in fine brown earthy ironstone ; but these belong to the later part of the tertiary volcanic epoch. At a time then when the physical features of the country were somewhat similar to what they are now, and its surface, probably some 20 feet or so higher than at present, was covered with an eocene flora, volcanic energy revealed itself in the first eruptions of basalt. The hard rocks of the quartz-porphyry, felstone, and granite, were rent open ; and, where the volcanic forces became centralized, small cones were thrown up composed of comminuted fragments of the underlying rock and scoriaceous basalt. The lava emanating from these centres, poured into the valleys in streams from 100 to 200 feet thick, flowing for a distance of from 6 to 12 miles. Dispossessed of their old beds, the creeks and rivers had to wear for themselves fresh channels, either down the centre of the lava stream, or along one or both of its margins. It is probable that in accordance with facts observed in connection with recent lava streams, the sides of these old basalt flows in contact with the cold rim rocks would cool and consolidate, while the centre of the mass was still fluid. The result of this would be that the centre of the stream would flow away from the sides, leaving them at a higher level, and so giving rise to a slight central depression. This would favour the erosion of the new channel immediately over the site of the old one, where the lava must necessarily have been thickest and so most fluid, and where consequently the lowest point of the depression should lie theoretically. More frequently, however, the water chose the junction lines of the basalt with the palæozoic rocks. That the volcanic activity was prolonged for a vast space of time is proved by the extent of denudation which has taken place between the older flows of lava and the newer. The amount of this can be measured at the upper end of the Vegetable Creek Lead at Rose Valley. [*See* Section 2 C—D.] The section at Griffith's and Fox's shafts shows that a watercourse has cut through one or more flows of basalt altogether to a depth of about 60 feet. Then succeeded another flow of basalt, which buried the second channel to a depth of 100 feet. These second eruptions appear to have been less violent than the first, the lava welling up, probably from wide rents, and producing the low gently sloping cones of solid lava, destitute of the volcanic dust and scoria characteristic of the earlier outbursts. Evidence as to which is the latest flow of basalt is rather meagre, but judging from the general freshness of the appearance of the lava at Kangaroo Flat, in portions 70 and 73, parish of Arvid, it seems to me that this flow is one of the most recent. Powerful streams must have flowed in places over the surface of the basalt long after its consolidation, as evidenced by the coarse pliocene gravel in portions 696 and 751, parish of Strathbogie, where some of the water-worn blocks are over 1 foot in diameter. This gravel is, roughly, about 150 feet above the Severn River. At the time such a coarse gravel was formed it is scarcely conceivable that the present Severn Valley existed, and its erosion was therefore probably subsequent. Here, however, a question of great difficulty arises. The statement already made that most of the present river channels have been deepened by from 300 to 600 feet since the last lava flows, is generally correct; but what appears to be a remarkable exception to the general rule occurs at Strathbogie. For about a mile above the head station basalt occurs in position a few feet only above the level of the present river; and, on the left bank of the same river, a shaft sunk through the lava proves that it extends to a considerable depth below the river channel. Also on Swamp Oak Creek, 1 mile north of the north-east corner of portion 5, parish of Astley, the basalt comes down within a few feet of the level of the creek. In the latter instance the position of the basalt may be partly due to landslips; but the first case is incapable of such an explanation, and the interpretation of this phenomenon must be deferred until a geological examination is made of the country south of the Severn River.

These patches of pliocene river gravel show, that at the close of the tertiary volcanic period the outpouring of the lava streams by filling up the valleys had locally raised the level of the drainage channels. Running water, however, ceaselessly fretting the rocks, by degrees wore fresh troughs as deep as the old ones, and eventually considerably deeper. The heavy rainfall of the pleistocene period must have materially accelerated this work of erosion; but in this rocky district, with its steep falls, little trace is preserved of pleistocene deposits, except in the wide plains of coarse gravel in the valley of the Dumaresq. The shallow deposits of subangular gravel and sand in the beds of the present creeks and rivers were evidently formed under conditions similar to those which now obtain; and their stratigraphical position, as well as the occurrence in them of natives' stone hatchets, proves them to belong to the recent period.

PART VI.

ECONOMIC GEOLOGY.

The subject has been divided according to the different minerals of economic value found in the district.

These have been classed as metallic and non-metallic, and consist principally of the following:—

Metallic—

1. Ores of Tin
2. „ Silver
3. „ Lead
4. „ Copper
5. „ Antimony
6. „ Iron, manganese, arsenic
7. „ Tungsten
8. „ Bismuth and molybdenite
9. „ Zinc.

Non-metallic—

1. Gems
2. Pipeclay
3. Lime
4. Coal.

TIN.

Tin is found combined with oxygen as the mineral cassiterite, or tinstone, in more or less quantity throughout the whole of the Vegetable Creek District. The metal has also been found here as sulphide in stannite by Mr. C. S. Wilkinson.

Tinstone occurs in—1. Veins.
2. Stream-works.

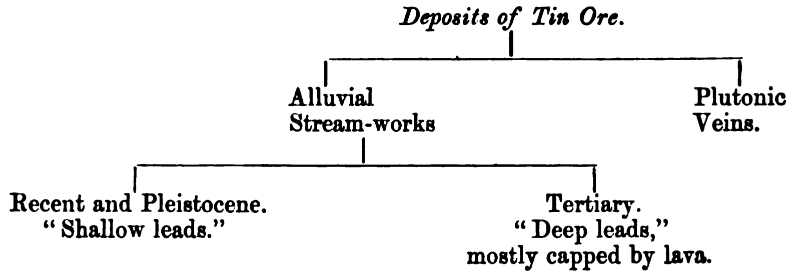
The veins occur in palæozoic rocks of granite, quartz-porphyry and claystone, and have been formed at great depths below the surface.

The removal of vast piles of superincumbent rock has laid the veins bare, and exposed them to the disintegrating influence of the atmosphere. The breaking up and wearing down of a great number of such tin veins has caused fragments of tin ore to accumulate in their vicinity, and these fragments having been gradually swept into the bottoms of the valleys, and there further pulverized by the action of water, have been mingled with the sand and gravel of creeks and rivers as stream tin.

Such deposits containing small waterworn pieces of tinstone constitute stream-works.

2. The stream-works, which have been formed in post-tertiary time, not being as thick as the older accumulations, are popularly called "shallow leads," while the latter are termed "deep leads."

The local deposits of tin ore may therefore be classed as follows, according to their mode of origin:—



Well-rolled quartz pebbles are found occasionally, derived from a small outlier of tertiary sand and gravel which crosses the present Vegetable Creek, near the north-east corner of portion 540, parish of Strathbogie North, having a length of ½ mile, and an average width of 40 feet.

The depth of sinking in this patch varied from 10 to 25 feet.

The stream tin in this outlier showed a mixture of well-rolled tertiary with subangular post-tertiary pebbles. The "wash" was from 2½ to 3 feet thick, and next to the bed rock, the average yield of ore being ½ cwt. per ton. 300 tons of stream tin were obtained at the "Great Britain," in a space 6 chains long and 40 feet wide. At "Moore's Mine," on the Vegetable Creek, at Emmaville, the "wash," which was 2½ feet thick, averaged 80 lbs. to the load.

At the "Baal-Gammon," 50 tons of ore were washed out of an area measuring 1½ chain by 1 chain. The size of the fragments of tin ore in the wash varies from ½ inch to $\frac{1}{20}$th of an inch in diameter. Some are well-formed crystals, with sharp edges and unbruised faces. Others are so much abraded as to resemble shot.

The prevailing colour is black, with a fair proportion of resin ruby, and a little grey ore. In some cases all these shades of colour may be noticed in the same specimen.

The total yield for the 150 acres of ground worked from 1872 to 1884 has been, as already stated, 15,000 tons, or about 100 tons per acre. The average thickness of the wash being 2½ feet, 1 acre (4,840 square yards) would contain in round numbers 4,030 cubic yards of wash dirt, $\frac{100}{4030} = \cdot 0248$ of a ton per cubic yard, and taking 1 cubic yard of tin gravel to weigh 1 ton, = 2½ per cent., = ½ cwt. per cubic yard.

Nine-Mile, Wellington Vale.—The recent workings here are located chiefly between portions 71 and 65, parish of Wellington Vale, where they have a length of 60 chains, a width of 2 chains, and a depth of from 3 to 14 feet, the average depth being 7 feet. The beds are composed of ferruginous clay, with quartz sand, and fragments of felspar crytals.

The thickness of the wash, which rests on a bed of porphyrite, varies from 6 inches to 2 feet. The average yield is about 20 lbs. of ore per cubic yard of wash dirt.

Patches measuring $\frac{1}{2} \times \frac{1}{2}$ chain have yielded 2 tons of stream tin, but this richness is very exceptional.

The tinstone is chiefly yellow and resin, with a fair percentage of ruby and black ore.

The grains are mostly much worn, with a few sharp fragments interspersed.

The size of the grains varies from that of a fine dust to $\frac{1}{4}$ inch in diameter, the average size being $\frac{1}{20}$ inch in diameter.

Associated with the tin ore are quartz, zircon, and spinel. A similar quality of ore occurs on the surface near south-west 119, where the crystals are very sharp and angular. Stream tin in the Nine-mile Creek has evidently been derived from this source.

In portions 520 and 521 in the same parish, tin gravels, probably of pleistocene age, cover granite and basalt to a depth of at least 20 feet. The deposit consists of coarse subangular granite sand, with subangular lumps of reef quartz, containing tinstone from 4 to 5 inches in diameter. Very few well-rolled tertiary pebbles are met with. The stream tin is more worn than that in the recent gravels, and contains more black tin. The average diameter of the grains is $\frac{1}{15}$ inch. A shallow lead has been worked in portions 520 and 521, where the lead rests on a bed of older soft basalt, and apparently skirts the margin of the hard basalt.

On the west side of Battery Creek, in W.R. 301, 40 tons of stream tin have been extracted.

The ore in these pleistocene beds resembles that in Davy's lodes, and has probably been derived from them.

The total yield of ore from the shallow workings in the Wellington Vale Lead is about 70 tons.

At Tucker Gully, near Nine-mile, in portions 277 and 278, parish of Annandale, county Clive, a swampy flat, having a length of $\frac{1}{2}$ a mile and a breadth of a $\frac{1}{4}$ of a mile, has been worked for stream tin.

The bulk of the deposit is probably pleistocene, but on the left bank of the creek a small area is occupied by recent gravel, which is coarser and more angular, contains more brown tin, and is looser than the pleistocene gravels. The general surface of the latter is 5 or 6 feet higher than that of the former.

The pleistocene beds are from 10 to 20 feet thick, the average thickness being 14 feet, and consists of fine white and yellow quartz sand, with lenticular patches of coarse granite sand and fine dark sandy clay, and rest on a bed rock of granite. The wash, which shows current bedding in places, occurs in patches from 6 inches to 3 feet thick, and consists of quartz sand, and subangular fragments of quartz 1 inch in diameter, a few containing reef tin.

The average yield of ore is about 30 lbs. per cubic yard.

The tin is chiefly black and subangular, with a fair admixture of resin and ruby ore. Some of the grains are much waterworn, others have very sharp edges, evidently not having travelled far from their original matrix. The diameter of the grains runs up to $\frac{1}{4}$ inch, the average measurement being $\frac{1}{15}$ inch.

Catarrh Creek.—The shallow recent alluvial beds here have a length of about 1 mile, extending down the left bank of the creek from portion 14 to portion 24 in the same parish. The width varies from 3 to 7 chains, and the depth to the granite bed-rock, from 10 to 14 feet. The constituents are fine clean granite sand with round and subangular pebbles of quartz, granite, and greisen, up to 5 inches in diameter. A few well-rounded tertiary pebbles were observed in these gravels.

The stream tin is mostly black, but resin and ruby varieties are also present. The grains are very much waterworn, unbruised crystals being very rare; the average diameter of grains is $\frac{1}{20}$ inch.

This deposit evidently consists partly of tertiary sands and gravel, redeposited in recent geological times; 1,000 tons of stream tin are said to have been obtained from these alluvials.

Blather Arm.—The sand and clay in these alluvial workings, in portion 42, parish of Bates, county of Clive, are from 10 to 15 feet deep, and consist of subangular granite sand, with subangular and round quartz pebbles up to 6 inches in diameter, and rest on a bottom of granite. White topaz and sapphires are very abundant. The stream tin is chiefly black, but resin and ruby tin is sparingly present. The grains are much waterworn, sharp crystals being the exception. The largest of the grains are ¼-inch in diameter, the average being 1½ inch.

In Moleyard Creek, a tributary of Oakey Creek, the stanniferous gravel is similar to that at Blather Arm, with the exception that it contains pebbles of claystone, derived from a neighbouring outlier of that rock.

At Bald Rock Creek, in the parish of Binghi, county Clive, stream-tin sands and gravels have been worked to a depth of about 10 feet on to the granite bottom. The beds consist of subangular and round quartz sand, with fragments of quartz veinstone, granite, and claystone—the largest being 6 inches in diameter. The stream tin, which is well rolled, is chiefly black, with a fair sprinkling of resin and ruby and a little grey or brown ore. The largest are a ¼-inch in diameter, the average gauge being 1/12 inch.

Fragments of topaz are plentiful in the wash.

The Gulf, Deepsinker's Gully, Nuggetty Gully, &c., form a swampy sand flat, the gathering ground of some small tributaries of the Beardy River.

Stream tin has been worked at intervals for a distance of over ¾ quarters of a mile, from portion 17, to portion 4, parish of Muir. The alluvials, which rest on a granite bottom, are from 12 to 25 feet thick, and are formed of current-bedded, compact, granite-sand, varying from angular to subangular, and from fine to coarse. These superficial deposits have been worked for a width of from 14 to 20 feet. The thickness of the wash varies from 1 to 2 feet, and averages 1½ cwt. per cubic yard.

The stream tin, which is black, is coarse and well worn.

In the road, between portions 6 and 31, parish of Muir, nuggets of black tin ore were found close to the surface, the largest weighing 32 lbs.

Coarse river gravel (area shown on the map, about 8 square miles) includes recent and pleistocene gravels on the left bank of the Dumaresq River, between the confluences with it of the Reedy Creek and Beardy Rivulet, as well as small belts of gravel extending a few miles up these streams and the intermediate tributaries of the Dumaresq, Gulf, and Black creeks. The thickness of these gravels is not known. The greater part of the gravel is a coarse shingle composed of waterworn blocks of claystone, quartz-porphyry, granite, and other local rocks. A small quantity of stream tin has been worked in Black Creek, near portion 12, parish of Fraser, county Gough, but as far as I am aware these extensive gravel deposits have not been tried for stream tin elsewhere.

TERTIARY DEPOSITS.

With regard to mining these have been classed as—

1. Bare.
2. Capped by lava.

This division does not imply that there is any great physical or geological difference between the deposits of tin gravel to which it is applied, for the same bed, which is bare at one point, may be covered by lava at another, and yet preserve throughout the same essential characteristics.

1. Bare Deposits.

At Scrubby Gully, an isolated patch of older tertiary tin gravel lies high up amongst the granite hills of the Mole Tableland (over 1,000 feet above the level of the nearest river—the Beardy), with an extent of only 11 acres, and a thickness of from 2 to 14 feet; it has yielded, up to date, over 500 tons of stream tin. The tinstone here is mixed through a gravel, formed of intensely worn pebbles of quartz, topaz and beryl covered by a felspathic cement, similar to that at Emmaville. The grains of tinstone are nearly all very much worn, sharp crystals being very rare and small. Tin nearly all black, a very little ruby ore. Average diameter of grains $\frac{1}{4}$ inch.

At Surface Hill, a similar patch of gravel occurs, 1 acre in extent and from 1 to 2 feet thick, also rich in black stream tin. The pebbles of quartz and green beryls(emerald), zircons, &c., associated with the tin are all intensely worn, some of the quartz pebbles being 6 inches in diameter. The grains of tin are coarser here than at Scrubby Gully, averaging $\frac{1}{10}$ inch in diameter, and are all intensely worn. The abundance of tourmaline in these gravels, suggests that they have been derived partly from the waste of the schorlaceous granite at Macdonald's tin veins on the Glen Creek. This formation however, is over 3 miles distant, and is now nearly on the same level.

At Ruby Hill, in portion 38, parish Lockerby, is a patch of gravel a few chains in extent, closely resembling that at Scrubby Gully.

The deposit which is about 4 feet thick, consists of well rolled older tertiary quartz pebbles up to 1 inch in diameter, set in a felspathic sandy cement and resting on a bottom of quartz and felspar porphyry. The tin ore is very fine and black.

By far the most important deposit of this class, is that known as the Y. Water Holes and Graveyard Lead. This formation, consisting of laminated pipeclays and red current-bedded sand, has an area of 1 square mile 450 acres, and a depth of from 10 to 60 feet, the average depth being 20 feet. The nature of the clay and sand beds forming this deposit, is shown on Fig. 1, page 40.

Few pebbles are found at the Y. Water Holes, but traced towards the Graveyard, the pebbles increase in size and number. In the Vegetable Creek Companys Mine at the Graveyard they are 1 foot in diameter. At the Y. Water Holes the sands are composed of irregularly shaped subangular grains of dark quartz, $\frac{1}{4}$ inch in diameter, such as may have been derived from coarse granite. Associated with these are a few intensely worn polished pebbles of reef-quartz, $\frac{1}{2}$ inch in diameter. The cementing medium is red peroxide of iron and clay.

Most of the stream tin is fine, averaging $\frac{1}{50}$ inch in diameter; the grains are well worn. In portion 58, parish Scone, however, the tin is coarser and more angular, fragments $\frac{1}{2}$ inch in diameter being of common occurrence. Zircons, locally called "brass filings" or "green tin," titaniferous iron ore, spinel, and magnetite are mixed through the gravels, and on account of their high specific gravity are difficult of separation from the tinstone.

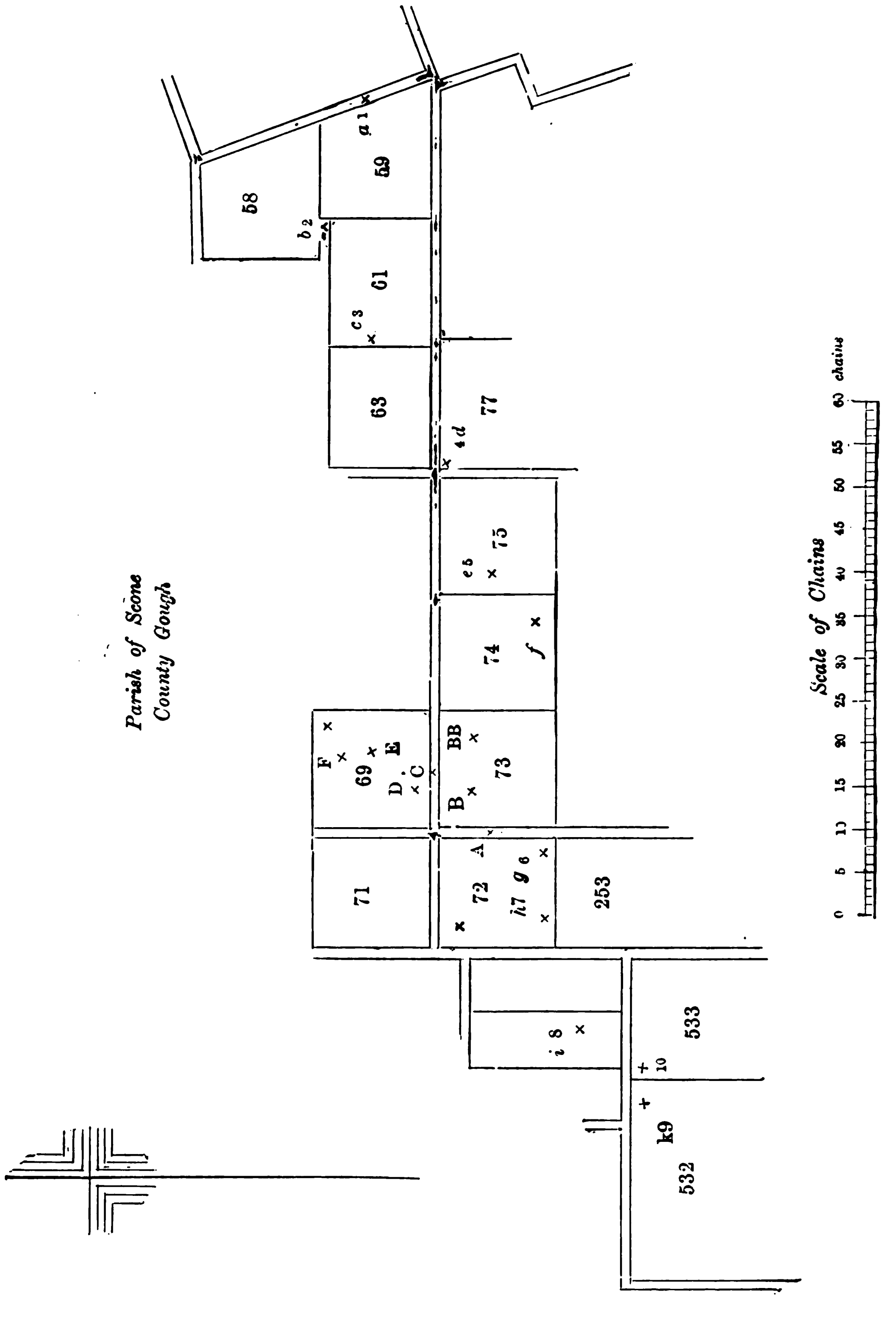
DISTRIBUTION OF ORE.

Vertical sections show that the stream tin is almost entirely confined to the sand beds, and is most abundant at their base within a distance of from 2 to 3 feet above the rock, and at the surface, for a foot or so downwards. The intermediate sand, though poorer in ore, yields from 6 to 7 lb. per cubic yard.

The richness in ore of the base of the beds is obviously due to the high specific gravity of the tin-stone, causing it to work its way through the lighter quartz sand on to the bed rock.

The surface is richer in stream tin than the intermediate beds, owing to its having received the tin from sluicings of a considerable thickness of sands once overlying, but subsequently removed by denudation. As regards the horizontal distribution of ore, no definite channel has been found in the outlier on the east side of the Y. Water Holes, the ore being disseminated all through the base and surface of the beds without being concentrated in a channel, the deposit probably being lacustrine. West of the Y. Water Holes a defined channel has been worked by O'Mara, in portion 1, parish of Scone, and followed by Murgatroyd in portion 58, Davidson and Gibson in portion 61, Kirker in portion 63, and David Lewis in portion 75. At O'Mara's workings the channel was from 30 to 130 feet wide, and the tin-bearing gravel, chiefly clean white sand, from 7 to 8 feet thick. A small feeder was followed here coming in from the north-east. At Murgatroyd's the pay channel was from 20 to 80 feet wide, and the pay gravel from 1 to 2 feet thick, yielding from 30 to 40 lb. of ore per cubic yard. The wash from the north side of portion 58, in which this mine is situated, contains coarse grains of tin-stone up to $\frac{1}{2}$ inch in diameter, some sharp, the average diameter of the tin grains being $\frac{1}{50}$ inch. In portion 61 two channels have been worked. The tin in the south channel was coarser than that in the north. At Davidson's and Gibson's the lead was about 140 feet wide, the wash averaging from 2 to 3 feet thick, but in places 7 feet, and yielding 40 lb. of ore per cubic yard. At Kirker's the gutter was 80 feet wide, the wash from 2 to 5 feet thick, yielding 28 lb. per ton. At David Lewis's a small patch of clayey gravel, containing small pebbles of quartz-porphyry, has been worked at 50 feet below the surface, but it is doubtful whether this is on the same channel as Kirker's. There is a steady fall in the surface of the bed of the rock underlying the tertiary beds from *a* 1 shaft to *e* 5, amounting to 10·70 feet in a distance of 60 chains. [*See* fig. 4.]

FIG. 4.


Parish of Scone
County Gough
Scale of Chains
0
5
10
15
20
25
30
35
40
45
50
55
60 chains
58
59
a 1
b 2
61
c 3
63
77
4 d
75
e 5
74
f
69
F
E
D
C
BB
B
73
A
71
72
g 6
h7
253
i 8
533
10
k9
532

The lead, which has been proved at intervals up to this point, has been lost here; and as the present water-parting between the Severn River and Glen Creek runs a few chains to the west of this last shaft, it may be the case that a similar water-parting exists underground in the bed-rock shutting off the Y. Water Holes from the head of the Graveyard Lead. A new lead has recently been discovered to the north-west of this water-parting, and apparently distinct from the Y. Water Holes Lead. Certainly the upper end of this gutter can have no connection with the tin wash proved at *e* 5, as shown by the levels; besides, the sands in the Race-course Lead are white, like those at the Graveyard, while the bulk of the Y. Water Holes sands are red. Red sands, however, do exist in the Graveyard Lead [*See* Vertical Sections at Casley's Shaft], and clean white sands are found at O'Mara Shaft, &c., at Y. Water Holes. As regards the difficulty of levels, the surface of the bed rock at B.B. is sufficiently low to have let through the lead lost at *e* 5. It is still possible, therefore, that there may be a narrow opening through the bar between *e* 5 and BB, connecting the two leads. In this case the lead heading from F must be a feeder. For the sake of convenience, however, the line of water-parting may be taken as the western boundary of the Y. Water Holes Lead. The mass of stanniferous sand included within the area of the Y. Water Holes Lead, as so defined, has a superficial area of about 300 acres. The richer patches of gravel, averaging 35 lb. of ore per cubic yard, have been practically exhausted; but estimating the average thickness of sand at 6 feet, and the average yield at 6 lb. per cubic yard, the total quantity of ore contained in these 300 acres would amount to over 7,500 tons. The accompanying plan and levels, kindly placed at my disposal by Mr. A. Cadell, C.E., shows the relation of the Y. Water Holes Lead to the Graveyard:—

REDUCED LEVELS.—Y. WATER-HOLES AND RACECOURSE LEAD.

Surface Level.	Bottom Level.	Depth of Shaft in feet.	
3029·20	3001·70	27½	*a.* 1. Three to six feet of wash.
3033·	2998·	35	*b.* 2. Wash four feet.
3040·28	2993·28	47	*c.* 3. „ „ „ Davidson and Kirker's.
3042·80	2993·80	49	*d.* 4. Not much tin but plenty of fossil leaves.
3035·02	2991·	44	*e.* 5. 1½ feet to 2 feet wash, good tin.
3030·42	B. M.		
3027·54	2985·54	42	*g.* 6. No tin, dipping north.
3026·10	2980·10	46	*h.* 7. Two feet payable wash.
3021·12	2979·12	42	*i.* 8. 9 inches to 1 foot 6 inches wash, and lots of poor sand.
3020·02	2974·02	46	*k.* 9. Proctor's.
„		45	(Pathfinder's). Little tin, not payable.
3029·20	2987·20	42	A.
3029·28	2987·75	41½	B.
3029·26	2981·28	48	B. B.
3029·84	2984·84	45	C.
3334·74	3032·74	32	E.
3027·94	3015·94	12	F.

The Graveyard Lead.—The rich tin gravels in this lead have a more defined shape than those at the Y. Water Holes, evidently having partly been formed along the bed of a silted-up watercourse. The Race-course Lead probably marks the source of the main channel, which, rising from the north-east corner of portion 69, Scone, flowed in a south-westerly direction parallel with the present Graveyard Creek. At the source, the tin gravel is 12 feet below the surface, increasing to over 40 feet within a distance of $\frac{1}{4}$ mile. A continuation of the channel has been worked by Proctor, in portion 532, parish of Scone, for a distance of 10 chains, 9 tons of ore being won; then for a space of 25 chains the lead has been lost, but the gutter has been proved again in portion 534, parish of Scone, for a distance of 2 chains, by Louis Webb and party, then lost for 20 chains, until portion 195, parish of Scone, is reached, where the lead has been worked for several chains by Francis and party. At this point, a branch lead or feeder junctions with the main lead, falling in from the north-east. This feeder has been worked for a distance of 13 chains, and consisted of quartz sand, round and sub-angular, the grains having the shape of double hexagonal pyramids, a few well-rolled pebbles of quartz $\frac{1}{4}$ inch in diameter, and angular fragments of quartz veinstone containing tinstone. At Francis' workings on the main channel, the stanniferous wash was composed of quartz sand derived from the waterworn blocks of the same rock up to 1 foot in diameter. The wash was from 3 to 6 inches thick. The stream tin, chiefly well worn, is decidedly coarser than that at the Y. Water Holes, the grains averaging $\frac{1}{20}$ inch in diameter. West of portion 195, in portions 202, 200, 199, and 198, the lead has been extensively worked at the old "Gaveyard Mine" by the "Vegetable Creek Tin-mining Company," then by tributors Casley, Curtin, Fontana, &c. The width of the payable gravel here was from 1 to 4 chains, and the thickness of the pay drift from 1 to 4 feet, averaging 2 feet thickness, and yielding an average of 38 lb. of tin per cubic yard. The stanniferous drift consists of fine, very clean quartz sand, the quartz occurring in rounded and sub-angular doubly-terminated crystals, with a few well-rolled tertiary quartz pebbles $\frac{1}{2}$ inch in diameter, and in the centre of the channel blocks of quartz-porphyry over 1 foot in diameter. The tin is chiefly well-worn and black, $\frac{1}{40}$ inch in diameter. Zircons, sapphires, titaniferous iron, spinel, and magnetite are plentifully intermixed with the tin ore. At the old Graveyard workings the sedimentary beds are capped by laterite, from 27 to 40 feet thick, making the depth of sinking, from surface to bed rock, over 100 feet, so that at this point the bare deposit merges into a deep lead. An outlier of laterite has already

The lead, which has been proved at intervals up to this point, has been lost here; and as the present water-parting between the Severn River and Glen Creek runs a few chains to the west of this last shaft, it may be the case that a similar water-parting exists underground in the bed-rock shutting off the Y. Water Holes from the head of the Graveyard Lead. A new lead has recently been discovered to the north-west of this water-parting, and apparently distinct from the Y. Water Holes Lead. Certainly the upper end of this gutter can have no connection with the tin wash proved at *e* 5, as shown by the levels; besides, the sands in the Race-course Lead are white, like those at the Graveyard, while the bulk of the Y. Water Holes sands are red. Red sands, however, do exist in the Graveyard Lead [*See* Vertical Sections at Casley's Shaft], and clean white sands are found at O'Mara Shaft, &c., at Y. Water Holes. As regards the difficulty of levels, the surface of the bed rock at B.B. is sufficiently low to have let through the lead lost at *e* 5. It is still possible, therefore, that there may be a narrow opening through the bar between *e* 5 and BB, connecting the two leads. In this case the lead heading from F must be a feeder. For the sake of convenience, however, the line of water-parting may be taken as the western boundary of the Y. Water Holes Lead. The mass of stanniferous sand included within the area of the Y. Water Holes Lead, as so defined, has a superficial area of about 300 acres. The richer patches of gravel, averaging 35 lb. of ore per cubic yard, have been practically exhausted; but estimating the average thickness of sand at 6 feet, and the average yield at 6 lb. per cubic yard, the total quantity of ore contained in these 300 acres would amount to over 7,500 tons. The accompanying plan and levels, kindly placed at my disposal by Mr. A. Cadell, C.E., shows the relation of the Y. Water Holes Lead to the Graveyard :—

REDUCED LEVELS.—Y. Water-holes and Racecourse Lead.

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3030·42	B. M.		
3027·54	2985·54	42	*g*. 6. No tin, dipping north.
3026·10	2980·10	46	*h*. 7. Two feet payable wash.
3021·12	2979·12	42	*i*. 8. 9 inches to 1 foot 6 inches wash, and lots of poor sand.
3020·02	2974·02	46	*k*. 9. Proctor's.
„		45	(Pathfinder's). Little tin, not payable.
3029·20	2987·20	42	A.
3029·28	2987·75	41½	B.
3029·26	2981·28	48	B. B.
3029·84	2984·84	45	C.
3334·74	3032·74	32	E.
3027·94	3015·94	12	F.

out of the channel. At a point 32 chains westerly from the 130-feet shaft, a prospecting shaft has been sunk by Hurley and Conlon, subsequently bottomed by Casley and party at 124 feet. Coarse red sand, 32 feet thick, as shown on section No. 3, was passed through in the upper part of the shaft, and at 44 feet from the surface hard basalt was met, this being the furthest point east on this lead to which the last named rock has been proved to extend. This shaft was bottomed on claystone, there being a thickness of 9 feet of water-bearing sand next to the bed rock. Red sands similar to those in the upper part of the preceding shaft may be seen outcropping from under the laterite, wherever it has been cut through by gullies, as along the east line of portion 526, towards the south-east corner. On the east line of portion 525, Scone, a line of shafts have been sunk, which prove that the tertiary beds are thickest, and the made ground deepest near the south-east corner of portion 525, Scone. Three shafts have been sunk here in hard basalt to depths of 97, 101, and 103 feet respectively, but I was unable to ascertain whether any of them had been bottomed, no sand being visible in the spoil-banks around the mouths of the shafts, and their sides having fallen in. The true channel probably lies between the 97-feet shaft and a point some few chains south of the south-east corner of portion 525. The trend of the gutter west of this point is still more doubtful. An inlier of bottom rock shows at the surface in portion 517, Scone; the ground between this and the bottom rock in portion 524 has the appearance of not being very deep, and the main line of water-parting runs about 15 chains to the south. The deepest channel here will therefore probably lie to the south of this outlier. West of this point the prospecting has been carried on in portions 516 and 512, Scone, Kennedy's and Reynold's selections, respectively. Several deep shafts have been sunk in Kennedy's selection, which have proved (1) that an upper layer of sand, said to contain stream tin, overlies the hard basalt here as at Hurley's shaft, and (2) that a branch lead enters the north-east corner of Kennedy's selection, falling from north-east to south-west, and underlying hard basalt 100 feet thick. This branch lead was originally supposed to be a continuation of the Vegetable Creek Tin-mining Company's original deep lead. Subsequent underground workings, however, tend to show that this is not the case, for

1. The only two possible openings in the bed rock have been well prospected, and yet show no made ground sufficiently deep to have let through the Vegetable Creek Lead. A series of shafts have been sunk across the first of these gaps, on the last line of portion 148, Scone, from 7½ to 29 feet deep, all said to have

been bottomed on to bed rock. The bed rock at the deepest point here is exactly on a level with the bed of the channel in the 83-feet shaft, in portion 718, Strathbogie North, 55 chains distant, and for a similar distance above this point the fall in the channel is 35 feet. Such an extent of level rock in the bed of a creek is unprecedented, so that the lead cannot have forced its way through this channel. The second opening in 547, Strathbogie North, must be discarded as a possible outlet for the main lead for similar reasons, the level of the bed rock being too high.

2. The main channel of the Vegetable Creek Lead, as shown on the plan, has been proved to the north-west for a distance of 1 mile past these strips of tertiary country. The character of the tin gravel in the branch lead very closely resembles that in the Vegetable Creek main lead, containing numbers of dark pebbles of opalized wood (black quartz) specially characteristic of the latter lead. Good coarse angular tin was found at the south-east corner of portion 129, Scone, in a shaft 75 feet deep; the stream tin gravel was a hard cement composed of sand grains agglutinated by felspathic material, and from 5 to 6 inches thick, while the channel was about 1 chain wide. The probability is that a low line of water-parting existed previous to the volcanic period, separating the Vegetable Creek from the Graveyard lead, the position nearly corresponding with that of the present water-parting between the two creeks. In times of heavy flood it is conceivable that a powerful body of water, rushing down the old channel of the Vegetable Creek Lead, would overflow the lowest points in the watershed at the sharp turn in portion 718, Strathbogie North, and perhaps even carry with it some of the tin swept from the bottom of the channel. Webb's workings south-west of this bend showed that the tin had been swilled up in this manner to a height of 10 feet above the bottom of the channel, as wherever large pebbles were found in Webb's Gutter the stream tin was invariably found, chiefly on the south-west side of the stones, showing that the currents which dropped it were flowing from the north-east. This branch lead may therefore be regarded as a tributary of

the Graveyard Creek, perhaps corresponding to the present Sheep Station Gully, and taking its rise on the southern side of the water-parting between the Vegetable and Graveyard creeks, and occasionally, perhaps, through a pass in this water-parting, forming a discharge channel or by-wash for the flood-waters of the Vegetable Creek. The point at which this tributary or feeder joins the main Graveyard lead probably lies somewhere near the south-west end of Kennedy's selection. Unfortunately there is considerable uncertainty as to the depths of some of the shafts in Kennedy's selection, the shafts having fallen in, and no record of the original depth having been preserved. The shaft said to have driven on wash at 80 feet from the surface is variously stated as being 129½ feet and 156 feet, and the character of the sinking was given as follows, from the surface downwards :—

72 feet ...	Laterite. Rotten olive-green basaltic soil.
8 „ ...	Fine white sand cemented with fine tin, like that at the Graveyard, resting on sandy pipeclay.
49½–76 feet...	Dense dark green basalt.

At the point shown on the plan at the north end of portion 516, stream tin was got in a shaft at 8 feet from the surface, on a bottom of felstone, the thickness of the tin cement here being from 1 to 1½ feet. The stanniferous cement cut in the preceding shaft may therefore have been a continuation of this shallow wash. At Reynolds' selection, joining Kennedy's on the west, a number of deep shafts have been sunk. Going westerly the first deep shaft, 156 feet deep, was bottomed on granite, the shaft being sunk through laterite and friable dark green basalt. No sand or gravel between the basalt and the granite bottom, was met with. The next shaft, 195 feet, was sunk through laterite and friable basalt into pebble beds saturated with water, the water preventing the shaft being bottomed on the bed rock. These pebbles exactly resemble those in the Upper Silurian, pebble conglomerates forming the rim rock of this lead at the south-east corner of portion 180, Scone, and are therefore probably derived from this source, and do not necessarily indicate the proximity of the main channel. In been bottomed on to bed rock. The bed rock at the deepest point here is exactly on a level with the bed of the channel in the 83-feet shaft, in portion 718, Strathbogie North, 55 chains distant, and for a similar distance above this point the fall in the channel is 35 feet. Such an extent of level rock in the bed of a creek is unprecedented, so that the lead cannot have forced its way through this channel. The second opening in 547, Strathbogie North, must be discarded as a possible outlet for the main lead for similar reasons, the level of the bed rock being too high.

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indicated by the outcrop amongst the sand beds of a seam of cement, the sand being glued together by silicates and oxides of iron; patches of such cemented sandstone occur at the points indicated in portion 522, especially at the north-west corner, and it might be as well to prospect the ground here for the upper lead in a south-east direction, to catch the lead below the junctions of the second and third feeders. It is strange, however, that such a shallow lead, if it exists, should not have been struck in the series of shafts sunk along the eastern line of portion 525, Scone.

As regards the lower level lead the prospecting shafts show that between the rope straining shaft in portion 201, Scone and the 130 feet shaft in portion 520 there is a fall in the surface of the bed rock of 69½ feet in a distance of 27 chains; that is more than twice the normal fall of the deep leads, which is 1 foot per chain. Under such circumstances there would be little chance of deposits of tin being retained on the bed rock in any quantity between these points; but further west, along the east line of portion 522, there should be some payable patches.

Another favourable locality for prospecting would be about the centre of Kennedy's selection, where the junction may be expected of the fourth feeder with the main lead. As regards the probable depth of the channel from the surface, if it should underlie this point, inferences may be drawn from the following data. At Hurley's shaft, 45 chains westerly from the 130-feet shaft, the surface of the bed rock is 31 feet below that of the latter, and probably this is not much above the bottom of the true channel. Taking the level of the channel here as 2,830 feet, allowing a fall of 1 foot per chain from here to the centre of Kennedy's selection, a distance of 80 chains, the level of the channel should, if underlying this point, be 2,750 feet; and taking the surface level at 2,950 feet, the depth of sinking would be 200 feet; and if the channel lies nearer the south-west corner of the portion the sinking would be from 20 to 30 feet deeper. By the same method of calculation the depth of the channel, should it underlie the 195 feet, 220 feet, or 170 feet shafts in portion 512, would be respectively 268, 312, and 238 feet, giving a thickness of sedimentary material of 73, 92, and 113 feet respectively. In the Vegetable Creek Lead, in portion 2, Hamilton, a corresponding distance from the source of the lead, the thickness of sedimentary material has been proved to be 79 feet, so the above estimate may not be excessive.

sources of the Y. Water Holes and Graveyard Creek. The Graveyard Creek contained payable tin from its source downwards for a distance of 3 miles to portion 139, Scone; but as soon as it left the quartz-porphyry for the claystone, the creek gravel became poorer in tin-stone. The claystone rock is therefore not favourable for stream tin, and leads cut through this rock are not likely to contain rich deposits of ore. The bar rock of the Graveyard lead is composed of this formation for over 3 miles west of portion 180, Scone, and as no payable tin has been found in the present gullies draining its surface, the lead cannot have been fed with tin along its north margin. The south bar of the Graveyard lead is composed principally of quartz-porphyry and felsite, apparently not rich in vein tin, as no payable deposits of ore have as yet been discovered in the recent alluvials where this formation obtains, between Y. Water Holes and Pipeclay Gully. The example of Ruby Hill, however, shows that a lead may contain payable tin even when the surrounding recent deposits are not payable, the tin-stone in this case probably having been disseminated in fine crystals through the mass of the rock. The discovery of fine stream tin in the tertiary gravels in M. L. ¾ proves that these quartz-porphyries must be to a certain extent tin-bearing. The inlier of similar rock in portion 736 and 19, Strathbogie, contains several thin veins of tin-stone, so that there is a probability of the lead having been fed at this point. The greater part of the rim rock may therefore be regarded as tin-bearing to a limited extent, and where the bar rock is not tin-bearing there is still the possibility of the presence of drifted deposits of detrital ore, as it has been proved in this district that stream tin can be swept for a distance of at least 2 miles from its source.

The yield of tin ore from the worked portions of the Y. Water Holes to the Graveyard, a distance of 3½ miles, offers a rather encouraging prospect for the unproved portion of the lead. This has a length of 5 miles. The unproved lead west of the Graveyard will be difficult to find on account of the width of the volcanic country, and when found, the channels though probably not rich, will contain large patches of gravel which may pay working expenses when the price of tin is good.

VEGETABLE CREEK LEAD.

The lower Vegetable Creek Deep Lead was first worked at its source, as a shallow deposit, at 18 feet from the surface, in portion 231, Strathbogie North, at a distance of over ¼ mile south of the main shallow workings on Vegetable Creek. The overburden consisted chiefly of pipeclay, and the sand or gravel composing the washdirt had an average thickness of 3 feet. The tin ore was black and well worn; that in portion 232 containing pellets up to ½ inch in diameter. The stanniferous gravel was found to run in a well-defined belt, at first westerly, and then south-westerly, and was followed by means of a tunnel 2,000 feet long, shafts being sunk at intervals. The surface of the ground was nearly level, but that of the underlying tin gravel was found to have a gradual slope to the south-west—here the gravel would widen from 18 feet to 90 feet, there it would become contracted again, and in places thin out altogether, and for a chain or so there would be no tin, merely a channel in the rotten surface of white quartz-porphyry choked with pipeclay. Such blank spaces in the lead were generally found to occur where the fall was more than usually steep, for where the bottom became more level the tin-bearing gravel invariably became thicker and richer. At one point in the main workings—near the roadway between portions 232 and 233—a good run of wash, 3 to 4 feet thick, was cut under a layer of hard cement 14 inches thick, and 16 feet below this again the main lead was worked. There could be little doubt, from the shape of the lead and the general character of the tin gravel, that the Vegetable Creek Tin-mining Company had struck an old river channel, and subsequent explorations have fully confirmed the supposition. At a distance of about 12 chains from the source a hard blue rock was met with in the sinking, overlying the pipeclay and tin gravel, and, as the tin continued to dip deeper under the tertiary country, this hard rock roof progressively thickened. At ¼ mile from the point of commencement, at a depth of 47 feet from the surface, the beginning of an extremely rich patch of tin gravel was struck—the underground channel widened from 30 to 400 feet, and the depth of tin-bearing sand and gravel in places reached as much as 14 feet, with an average thickness of 3 feet. A small feeder was found to come in from the east here, in portion 233, which has since been partially worked.

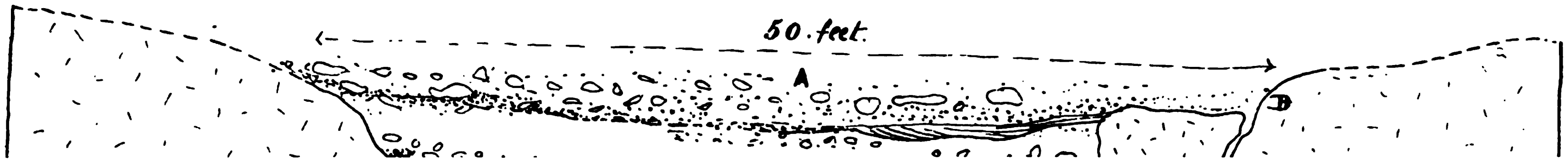
The main patch gradually became narrower as the slope of the channel was followed down to the south-west, and at the north-east corner of portion

235, at a depth of 60 feet from the surface, the tin gravel thinned out completely. The richness of this patch may be inferred from the fact that it yielded 2,000 tons of tin ore out of an area of 5½ acres of gravel averaging 3 feet thick—*i.e.*, it yielded over 1½ cwts. per cubic yard. From here the lead was proved at intervals running south-west, through Cubis' ground, portions 237 and 718. In Cubis' ground an upper bed of tin gravel was cut at 45 feet from the surface, separated from the underlying main deep lead by 28 feet of basalt. This upper lead was found to have a fall in a direction exactly opposite to that of the main lead. The seam of gravel probably forming the source of this run was struck in Watson's 82-feet shaft, in portion 718, Strathbogie North, at 12 feet from the surface. In portion 718, Strathbogie North, the lead took a very sharp bend, being doubled almost back on itself, and on the inside of this elbow a rich feeder, known as the old Rose Valley Lead, was proved to join it from the north. This was discovered by Mr. Reynolds at the surface in portion 230, and traced thence for a distance of 16 chains. The actual point of junction has not yet been proved, but is probably situated close to the sharp bend shown on the plan. The lead worked by Webb, in portion 718, for 6 chains south-west of this corner, although it belongs to the main lead, was probably a reef wash swept into its present position by storm-water, which would be apt to scour the gravel over the edge of the outer bank at this sharp narrow turn, and deposit it on the flat ledge where it now rests, 10 feet above the bottom of the main channel. The extension of tin gravel in this direction has been regarded by some as proof of the existence here of a channel connecting the Vegetable Creek and Graveyard leads. The pipeclay underlying the basalt at this point contains a profusion of fossil leaves and ferns. From here the lead runs north-east to the east boundary of the Wesley ground, the fall in the channel increasing from 1 foot in 104 feet to 1 foot in 58 feet, and this increase in the fall is attended with a narrowing of the channel, and thinning out of the tin gravel. The channel, however, though only 2 feet wide in places has been proved to be payable throughout the greater part of its distance, as far as the east line of portion 41, Hamilton, at which point a bed of Palæozoic conglomerate has interfered with the regularity of the channel, apparently splitting it into several narrow gutters, the southernmost of these known as Hamilton's Lead has been lost just after it enters the Wesley ground. Hume's Lead is probably a continuation of it. A very rich patch of tin gravel has been worked north of Hamilton's Lead and west of the conglomerate bar, at the north-east corner of portion 41, Hamilton. The stream beds here are from 130 to 137 feet below the surface, the richest

Tribute. At this point the quantity of water in the alluvials proved a great obstacle to the further development of the lead. The serpentine course of the lead through this area, and the well-defined rocky sides rising almost vertically to 12 feet above the bottom to form the banks enclosing gravel, combined with the fluviatile character of the beds, prove that the lead here is an old water-course; the fact being still further confirmed by the presence, higher up the lead in the Wesley ground, of abundant remains of land plants preserved in the pipe-clay. The character of the tin-gravel at Flannery's may be gathered from the accompanying Figure 5*. The channel was worked here for a distance of 30 chains; the width varied from 20 to 140 feet, averaging 80 feet; and the thickness of the wash ranged from 1 foot to 13 feet, the average thickness being about 6 feet. The total amount of ore won from this portion of the lead—1,600 tons, *i.e.*, over 100 lb. of ore per cubic yard of wash-dirt. From the sharp bend to the south line of portion 120, Hamilton, Flannery's Lead was worked down to the water level, on a false bottom of fine sand cemented in places with clayey material. Monkey shafts put down in places not having yielded encouraging prospects, it was decided not to go to the expense of draining the underlying sands.

* See accompanying plan.

Subsequent, however, to the expiration of Flannery and party's contract with the Wesley Company in July, 1883, O'Rourke and party, assisted by Fox's baling lower down the lead, were able to prospect the underlying gravels, and after passing through 12 feet of fine sand and sandy clay came upon very rich wash, from 1 to 4½ feet thick, resting on the true bed rock. The wash was composed of sand, passing into gravel and coarse shingle. The sand was made up of rounded and angular grains of quartz, mostly having the shape of a double hexagonal pyramid, and gravel of smooth pebbles of quartz-porphyry and quartz. There is evidence therefore here, as at Hume's Lead, of two rich grades of tin gravel—the lower resting on the bed rock, averaging 2 feet in thickness; the upper averaging 5 feet, and separated from the lower level by 12 feet of sand and clay. North of O'Rourke's the lead passes into Fox and company's 17½ acres block, and immediately over the lead here, on the surface, are two large patches of ironstone and iron-cemented sandstone. The strong body of water in the deep alluvials here, as well as in the next claim (Bailey's), have made the task of finding the channel very difficult and expensive. At the south-west end of the property an upper run of wash was worked from 5 to 6 feet in thickness, but scarcely payable; 18 feet of fine sand parted this upper run from the gravel of the main


50 feet.
A
B

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channel, the latter being 6 feet thick. The depth below the surface of the lower level wash here is about 160 feet. Through Fox's ground the main lead trends north-north-east into portion 20 (Hamilton), where Bailey's party are now working the lead. After three years of constant work they have found the main deep lead channel, and worked it for a distance of over 8 chains. An upper level of fine stanniferous sand was proved here under the basalt considerably above the tin gravel of the main channel. The drives in Bailey's workings afford excellent sections showing the line of junction between the eurite and claystone, or Lydian stone, as it may be more accurately termed. In Bailey's well shaft, when the eurite, which had mostly formed the bottom rock up to this point on the lead, had been penetrated to a depth of about 30 feet, a hard black jasperoid claystone containing pyrites, and veined with quartz, was found to underlie the eurite; and in a drive running northerly 59 feet along the junction line of the two formations, the surface of the Lydian stone was found to rise at the rate of 1 in 3 in this direction. The geological map shows that the junction line of the eurite and claystone should take place near Bailey's old shaft, bearing north-east and south-west, the claystone being on the north-west, and the eurite on the south-east. This hard bar of Lydian stone, as has been suggested by Mr. A. Cadell, is evidently the cause of the lead having been diverted from its westerly course in the middle of Flannery's workings and shot northerly through Fox's and Bailey's. Immediately over Bailey's deep channel an upper gutter was worked above the basalt, known as Proctor's shallow lead, so that here there were two grades of wash under the basalt and one above. The shallow lead was worked at a depth of from 16 to 80 feet from the surface. This is the lowest point to which the continuous workings on the main lead, from its source downwards, have been carried. The above observations justify the inference that these deep leads of stanniferous gravels occupy the channels of an old river and its tributaries, which for the rest of its course must obey the known laws affecting rivers. The lead must have a constant fall in its bed in the direction of the lowest point at which there was an outlet for its waters, and it will be enclosed between banks more or less defined. The channel, wherever the current has not been strong enough to sweep it bare, will be covered with gravel, and wherever the country drained by the lead is stanniferous, these gravels will contain stream tin. The bottom of the channel—from Vegetable Creek down to Flannery's old shaft, a distance of 125 chains, measured in a straight line in the direction of the general trend of the creek—is 141 feet (= about 1 in $58\frac{1}{2}$). The length of the channel between the same points is 165 chains, of which 115 chains contained tin gravel, while 45 chains were blank. The total amount of ore recorded as having been raised from the main deep lead from 1872 to 1884, between the old Vegetable Creek dam and Bailey's, is 4,478 tons.

Upper leads.—The sinking of shafts at various points along the course of the Vegetable Creek deep lead proved the existence of upper beds of stanniferous sand overlying the older basalt. For a distance of 2 miles west of their sources these upper leads are covered by sedimentary material only, but west of Bailey's they pass under the newer sheet of lava. The principal lead, known at its source as Skinner's Shallow Lead, started in portion 236, Strathbogie, and ran thence westerly through portion 230. Near the centre of this portion it was joined by a tributary lead falling in from the south-east. This tributary, at the shaft marked Hill's, bifurcates the left branch leading from Watson's 82 feet shaft from the south south-east, and the right falling in from the east. The left branch flows for part of this distance exactly over the channel of the deep lead, but the bed of its channel dips to the north, while that of the deep lead is inclined to the south. From its junction with the first feeder, the lead flows still westerly through portion 724; but near the centre of this portion its continuity is broken by a hard bed or bar of hornstone, locally called "black quartz." A blank piece of ground lies between the portion of the shallow lead on the east and that on the west of this bar. It is doubtful whether the continuation of it is represented by the upper lead crossing the Wesley boundary about the middle of the west boundary in portion 724, known as the Valley Shallow Lead, or by Griffith and Hammond's upper lead in portion 723. There is a fall in the bottom from this bar to the 51 feet shaft, 10 chains distance, of 11½ feet, and a fall from the bar to the nearest point of Griffith and Hammond's Lead, 9 chains distant, of 26 feet. The Valley Shallow Lead is therefore probably the continuation of Skinner's. This lead was worked into the Wesley ground for a distance of about 7 chains, but was not payable further west. The seam of stanniferous sand cut by Griffith in portion 41, and Flannery in portion 43, and Fox in portion 120, Hamilton, and found by them to overlie the hard basalt, was no doubt a further continuation of Skinner's shallow lead. This lead probably joins Fox's upper lead somewhere near the south-west corner of portion 20, Hamilton. A shorter, but far richer parallel running upper level lead, is that known as Griffith and Hammond's and Fox's Shallow Lead. This lead commenced in portion 719, Strathbogie North, where it was struck 66 feet from the surface. From here the payable tin gravel, as the working proceeded, was proved to lie in a horseshoe-shaped hollow, the bottom rock being partly basalt and partly eurite. The depth of this upper lead from the surface averaged 72 feet; the width of the gravel varied from 25 to 160 feet, averaging 100 feet; the thickness of the wash averaged 1 foot, and yielded 1 cwt. of ore per cubic yard. The wash consisting of waterworn pebbles and cement, rich in stream tin, had to be broken with sledge-hammers and puddled. Over 343 tons of ore were obtained here in an area of about 2 acres. This lead was lost at a point 3 chains south south-east of the north-west corner of portion 723, Strathbogie North; from here westwards the run has not been picked up again until the nearest point at which it was worked by Messrs. Fox and party in portion 47, Hamilton; so that there is an unworked space here of 8 chains. In portion 47 the lead varied in width from 20 to 150 feet; the depth of the gravel from the surface averaged 80 feet; and the thickness of the washdirt varied from 2 to 8½ feet, averaging 1½ feet, and producing 1½ to 2 cwt. per cubic yard. The shape of the deposit approximated to that of a horseshoe, and the bottom on which it rested was so uneven that no definite channel could be found. The general configuration suggests that it was laid down in a large rudely-semicircular waterhole, the deepest point of which lies at the bottom of the 92 feet shaft. The strata passed through consisted of volcanic dust and red sandy clays.

The last were found to be concreted in places into intensely hard lumps 4 feet in diameter by a siliceo-felspathic cement. It is doubtful whether any basalt in position was met with here. The lead was described to me as flanked on the south by a wall of hard basalt, and on the north by a sloping bank of quartz-porphyry. The lead was lost again at the point where the break is shown in the middle of portion 47, Hamilton. At shaft L the gravel which was 25 feet wide thinned out, and an empty channel was worked from this point for 82 yards, known as Vincent's Drive. From here the lead was quite lost for 3 chains, then an empty channel was discovered at the point shown in the middle of portion 47, Hamilton. The bottom of the channel at this point, however, was only 6 feet below the bottom of the 72 feet shaft, distant 25 chains. The average fall for watercourses at this point being 1 in 58, the channel here should have been 28 feet instead of 6 feet. Unless the deposit at the east end of 47 lies in a deep hole, with a point of discharge 10 or 12 feet above its deepest part, the true outlet for the eastern patch has not yet been discovered, and should be sought for by prospecting the south-west corner of 722, and the south-west corner of 47. Following the channel westerly into portion 120, Hamilton, from Conlon's shaft payable gravel was worked on the true bed rock to Q* shaft; the wash was 6 feet thick at O shaft, and is said to have averaged over 2 cwts. to the load. At Q the lead left the quartz-porphyry for the basalt, and so was worked here on a false bottom; at S shaft, 85 feet deep, this upper lead of Fox's crosses the underlying deep lead. This is the lowest point to which the upper lead has been followed, and the continuation of the lead may be said to be lost here, for although tin gravel has been worked further north the bottom was found to rise in that direction. At the point shown near the south end of portion 20, Hamilton, a branch lead comes in from the north, falling to the south-west. At this point the wash was 150 feet wide, 2 feet thick, and averaged 1½ cwt. to the load. It is doubtful at this point whether the lead called Bailey's Shallow Lead is a swill-over from Fox's lead, or whether it is a continuation of Partridge's shallow lead from the Red Hill. The levels show that the bottom is very uneven between the AA shaft and S shaft; but a continuous lead has been worked between these points, the bottom fall from the latter to the former being 28 feet in a distance of 11 chains. Two high bars in the basalt bottom intervene between AA and S, W 28 feet above AA and Z 22 feet. These bars may have diverted Partridge's shallow lead from its southerly course, and turned it west through the north-east corner of portion 5. As, however, there is a fall in the bottom rock, from the point where Partridge's shallow lead commences at the north-east corner of 338, to the S shaft, of 46 feet in a distance of 45 chains, Partridge's lead may eventually join Fox's Shallow Lead at the S shaft. In any case Fox's Shallow Lead terminates at the S shaft, having been followed now for a distance of ½ mile, within which space (of which 15 chains were nearly blank) 786 tons of tin ore were extracted. Bailey's Shallow Lead proper has been worked for a distance of 11 chains, having a fall in the bottom of its channel from north to south. It yielded over 114 tons of ore from 1880–1881. The fall, 50 feet in 13 chains, suggests that it has been formed, like Webb's dry lead in Rose Valley, by the sweeping up of the sands in heavy floods on the outside of the sharp bend.

The question now arises what has become of Fox's and Bailey's united leads—the levels taken at the lowest points in the bar rock between Fox's lead at S and the present Vegetable Creek, show that it is impossible for the lead to have escaped in that direction. Two alternatives suggest themselves, either the lead has gone westwards from Bailey's through portion 3, Hamilton, after the manner of the deep lead, or north under the hard basalt of the Red Hill, eventually entering the Vegetable Creek below the Rothschild Mine. The latter suggestion seems improbable from a comparison of the levels of the two outcrops of sand in the Red Hill, one at the north-east corner of portion 90, Strathbogie, the other near the south-west corner of portion 236; the former is 7 feet, and the latter 3 feet above the level of the bottom of the lead at Bailey's. The distance being 110 and 65 chains respectively, it is almost impossible that the shallow leads should have found an outlet in this direction. Therefore, the united upper leads must have gone westwards, and may, perhaps, follow approximately the line of junction between the laterite and hard basalt; in which case they should be prospected for near the north-west corner of portion 120, Hamilton. A well-defined outcrop of iron-cemented sandstone occurs in portion 10, Hamilton, striking west-south-west. As this has hitherto proved a guide as to the whereabouts of the channel, it might be advisable to sink some shafts at right angles to this on the north-west side of the belt of sandstone.

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* This lettering refers to a plan which will be kept for local reference at the Mining Registrar's office at Emmaville.

Partridge's Shallow Lead.—This lead, which may be a tributary of Fox's, has been traced from the south-west corner of portion 339, to the AA shaft 33 feet deep in portion 20, Hamilton, a distance of 25 chains. The depth of sinking varied from 30 to 50 feet, the strata passed through being a mixture of volcanic dust, clay, and sand. The lead in places was 70 feet wide, and yielded 186 tons 16 cwts. in a length of 350 feet. This lead has not been worked further south than the AA shaft. The shallow lead recently found in portion 1, Hamilton, is probably a continuation of this lead united with Fox's—Bailey's upper leads. The point where the confluence takes place is either at the S shaft or somewhere in portion 5.

Kangaroo Flat Lead.—The plan of the basaltic country and comparison of the levels show that this lead is a continuation of the united Vegetable Creek and Graveyard leads. The existence of tin gravel here was proved by the discovery of stanniferous gravel outcropping from under the basalt where the lava flow had been cut away by the present Vegetable and Glen creeks, near the north-east corner of portion 45, Arvid, at the Avoca Mine, near the north-east corners of 104 and 105 in the same parish. The tin gravel here, which is capped by basalt averaging 90 feet in thickness, has been worked in two channels on a nearly level bottom of claystone. The east channel has been worked for 30 chains, and the west for 35. The width of payable gravel varied from ½ chain to 4 chains, averaging 1½ chain. The gravel averages 2 feet in thickness, and is composed principally of flattish oval pebbles of claystone 2 to 3 inches in diameter, and well-worn pebbles and grains of quartz; and gem-stones, as green beryl, emerald, sapphire, topaz, &c., and fine grains of stream tin chiefly black. A great deal of clayey material is mixed with the sand and gravel, and this having been converted almost into brick by the heat and pressure of the overlying basalt, has turned the gravel into a species of conglomerate, so that one-half has to be puddled, and crushed under stampers before the tin can be extracted. The stream tin is distributed more plentifully through the thin fine gravels at the sides of the channels than in the coarser gravel lying in the channels themselves; so that the stanniferous gravel here may be described as a reef or beach wash. The total amount of ore raised here from 1872 to 1882 has been 909½ tons. As the bottom is so nearly level throughout it is hard to say whether the channels, from which this ore has been obtained, are one and the same, or two separate approximately-parallel leads. The level of the reef wash at Kangaroo Flat, as ascertained by aneroid, is 710 feet below the Post Office, at Emmaville, and 690 feet below the source of the Vegetable Creek deep lead. The distance from the last point to the south end of the Kangaroo Flat workings, measured along the general course of the lead, is 13½ miles, giving an average fall of 51 feet per mile.

At the Avoca Mine, ½ mile north of Kangaroo Flat, an outcrop of coarse well-worn shingle, from under basalt, has been worked on a small scale for stream tin, but found not payable. The gravel is far coarser than that at Kangaroo Flat, some of the blocks being 2 feet in diameter. The full thickness of the gravel here has not yet been proved, but cannot be less than 10 feet; the level is about 60 feet below the Kangaroo Flat gravel.

Stormer and party have found a patch of payable tin-sand in portion 111, Arvid, at a depth of 130 feet from the surface; the sinking was for 65 feet through fairly hard basalt, and then laterite and red clay. The bottom of the channel, as far as was proved at the time of my visit, was 15 feet below that of the wash at Kangaroo Flat. Another outcrop of tin gravel has been worked by Foley and party 1½ mile west of Kangaroo Flat; two grades of gravel have been discovered here, the upper covered by volcanic dust worked at 80 feet below the surface, on a bottom of basalt, at a level of

115 feet above Kangaroo Flat; the upper tin-sand averaged 2 oz. to the dish, *i.e.*, 30 lb. per cubic yard; the shaft was sunk to a total depth of 120 feet, the remainder of the sinking being in hard basalt; the bottom of the shaft was 75 feet above the level of the wash at Kangaroo Flat. In the adjoining portion 151, Arvid, the lower grade of wash, consisting of gravel, was proved at a depth of 80 feet from the surface, the capping being hard basalt. This wash is composed of pebbles 2 to 3 inches in diameter, of claystone and quartz-porphyry with quartz sand. Some of the pebbles are 1½ feet in diameter, and the gravel is coarser than that at Kangaroo Flat; the tin, however, which is chiefly black, is finer than that at Kangaroo Flat; the gravel is 7 feet thick in places, and averages from 25 to 30 lb. per cubic yard.

Half a mile south-west of Foley's is Hall's Sugarloaf, a small outlier of basalt capping stanniferous gravel. The basalt, which is hard, is 170 feet thick, and the tin gravel crops out on the south-west, south-east, and north-east ends of the outlier, the channel (if there is one) appearing to run from south-east to north-west. The gravel here, as described under General Geology, has been much indurated by the heat and pressure of the superincumbent lava, which has ridged it up into waves, so that the thickness is very variable, being from a few inches to 2 feet. The deposit may be described as a "cement" consisting of pebbles of claystone 3 inches in diameter with small well worn quartz pebbles, quartz sand, and small gems, as topaz and beryl, set in white and grey pipeclay, which has been baked in places into a tough natural brick. The cement is cleaner than the gravel at Kangaroo Flat and at Foley's, and is richer in stream tin. The stream tin which is chiefly black averages $\frac{1}{30}$ inch in diameter; the larger black grains associated with it are chrome spinel. The level of the cement at the north-east end of the outlier is 120 feet above that at Kangaroo Flat. One mile north-west of Hall's Sugarloaf are the "Surprise Mines." The gravel here is far coarser than that at Hall's Sugarloaf, Foley's, or Kangaroo Flat, and resembles that at the Avoca Mine, some of the waterworn blocks being 2 to 3 feet in diameter. The gravel lies in three distinct terraces, the top and middle terrace being richer in tin than the bottom. The floor on which the shingle rests in the top terrace is 62 feet below the wash at Hall's Sugarloaf, and 58 feet above that at Kangaroo Flat. That in the middle terrace is 42 feet above Kangaroo Flat, and in the bottom terrace 190 feet below. The top and middle terraces have been practically worked out, and have yielded over 150 tons of stream tin, the area worked being about 1¾ acres, the wash being from 3 to 16 feet thick and yielding 9 to 10 lb. of ore per yard. On the second terrace the gravel is from 10 to 30 feet thick, and yields 30 lb. to the load when the large blocks have been picked out. Some of the wash yielded 5 cwt. to the load. The trend of the beds is about north-west and south-east. Colours of gold have been found here. On the bottom terrace a considerable area of gravel remains unworked. This has been prospected by Messrs. Hopper and Bottrell (for Moore and Company) who have followed the gravel into the basalt from its line of outcrop for a distance of 450 feet. The bottom of decomposed quartz-porphyry was fairly level throughout, but rose rapidly at the far end of the drive. The bearing of the channel here is evidently north-west and south-east, and can be traced at intervals for three-quarters of a mile from Hopper and Bottrell's camp to the middle of portion 133, parish of Athol, county Arrawatta. The capping of basalt at the deepest point is from 160 to 170 feet thick; the thickness of the gravel averages 6 feet; and the width is as much as 5 chains in places. The coarse blocks of stone in the gravel, from 1 to 2 feet in diameter, render it impossible to treat the whole of the wash dirt simultaneously in the sluice-box; the larger lumps having to be carefully picked out by hand first. When this has been done the remaining sand and gravel yields as much as ½ cwt. of ore to the load; the average yield is 15 lb. per yard. The useless coarse blocks however detract from the value of the deposit in two ways. First, they take up a large proportion of the weight of every cubic yard of gravel raised; so that to get 1 yard of wash it is necessary to raise 3 yards of gravel; then in the second place the necessity of their removal from the wash increases the cost of treatment. As there is an excellent outlet for the tailings along the whole line of outcrop of this gravel, and a good supply of water could easily be obtained by enlarging the dam on the creek flowing through portion 290, a modified method of hydraulic sluicing might be adopted for the economical saving of the tin ore. The capping of basalt might prevent the gravel being sluiced away in position, but the separation of the ore could be effected in this way if the gravel to be treated were simply brought to the mouths of the tunnels. The quantity of ore is probably between 400 and 600 tons, *i.e.*, assuming the area to be 33 acres, and the average thickness of the gravel 3 feet, only 1 out of every 3 yards can be considered wash yielding ¼ cwt. of ore, an amount which would not justify the outlay of much capital.

A coarse shingle similar to the preceding occurs at the Fishing Grounds, portions 205 and 206, Arvid. The gravel here is 4 to 10 feet thick, and 200 feet below the level of the wash at Kangaroo Flat. Between Kangaroo Flat and Bailey's mine expensive prospecting operations have been carried on for over three years. The part of the lead which has claimed most attention is that between Bailey's and the Two-mile, and the basaltic spur north of Bailey's known as the Red Hill.

The Red Hill.—Levels taken at the lowest points of outcrop along this hill show that the stanniferous sands underlying the basalt cannot belong to Fox's shallow lead, and must therefore be a tributary of the main Vegetable Creek lead, standing in the same relation to it as Partridge's shallow lead to Fox's shallow lead. Although the deepest channel here has not yet been found there is sufficient evidence for inferring that the fall is from north to south. There is a fall of 37 feet from the bottom of the wash at the north end of the hill to the mouth of Hart and Swyny's tunnel in portion 339, Hamilton; and a fall, from the outcrop in the north-west of portion 9, Hamilton, to the bottom of the 50-feet shaft in the same portion, of 26 feet. The deepest ground as yet proved is that at the 50-feet shaft, and it is probable that the channel lies between this shaft and the south-east corner of portion 9.

Unproved ground on the Vegetable Creek Main Lead.—Following the basaltic country westwards from Bailey's, a number of shafts have been sunk by Cunneen in the eastern half of the portion. A channel has lately been discovered, at the point shown in the north-east corner of portion 5, which is considered a continuation of the main deep lead. Seventeen chains further to the west south-west in the same portion Moran has struck a channel 103 feet to water level, with a slight bar rising to the north and south.

The rock shaft in portion 2 was bottomed by means of boring rods at a depth of 209 feet, the greatest thickness of sedimentary material yet met with being passed through in the shaft. In Skinner's shaft in No. 1, and in Hart, Flannery, & Company's shaft an upper seam of sand was reached at depths respectively of 100 feet and 91 feet from the surface. This rested on a bottom of rotten basalt, which gradually became very hard. There are consequently two grades of tin-bearing sand here. At Barry's, still further west, in portion 52, Strathbogie, rich tin gravel has been worked for a short distance. The tin gravel was rendered more accessible here by the removal, through the erosive power of Stony Creek, of the overlying basalt. The sinking from the surface to the bed rock was through tough fine sand and clay; the depths of the shafts ranging from 58 feet to 66 feet. The bottom, which was of claystone, was found to be very uneven, so that it was hard to determine the direction of the channel; the bearing seemed to be west 20° south. The width was 100 feet, and the average thickness of wash 3½ feet. The wash consisted of clean, well-worn quartz-porphyry sand, and pebbles, and blocks of rounded claystone, the latter being as much as 2 feet in diameter. The roof is pipeclay. The average yield of this gravel was 1 cwt. of tin ore per load. Five chains west-south-west of Barry's, Kelly and party (late Bourke and party) found a rich patch of gravel, like that at Barry's, which has since been proved to pass under the bed of the present Stony Creek. Several prospecting shafts have been sunk between Barry's and Kangaroo Flat, the most important being Messrs. Wesley & Co.'s prospecting shaft in portion 137, Arvid. Several distinct sheets of basalt were passed through from the surface downwards. At 247½ feet from the surface sand was struck, passing towards the base of the bed, which was 7½ feet thick, into a rubbly gravel, composed chiefly of claystone. This rested on a false bottom of basalt; the shaft was sunk a further depth of 25 feet into this basalt without striking gravel, being still in the lava when work was discontinued. The total depth of the shaft was 280 feet. The bottom of the gravel is 125 feet above the wash at Kangaroo Flat, 480 feet below Fox's shallow lead at the S shaft, and 310 feet below the level of the bottom lead at Barry's. Alluvial tin has been worked on a small scale at two points intermediate between Bourke's and Kangaroo Flat. One at Mount Doubtful in portion 143, Arvid. This is an outlier of red sand about 5 acres in extent, capped by lava. The sands are current bedded, and partly cemented by red peroxide of iron; grey patches of clay lend the deposit a mottled appearance, like the stanniferous sands at the Y. Water Holes. The beds are about 10 feet thick, and are rather poor in stream tin. The sand is 280 feet above that in the Wesley Extended shaft.

Hogan's Lead was worked in portions 86 and 87, parish of Arvid, for about a length of ¼ mile. The tin wash was partly capped by volcanic dust and rotten pink basalt. The sinking here was comparatively shallow—from 10 to 20 feet.

SUMMARY.

The facts above stated with regard to the worked portions of the lead, and the prospecting done on the unworked portions, justify inferences with respect to the unworked area; first, as to the position of the channels; second, as to the probability of gravels in the unproved ground containing a fair percentage of stream tin.

1. Two questions are to be decided with regard to the position of a channel,—(*a*) its depth below the surface, supposing it to underlie any given point of which the level is known,—(*b*) its course underground, determined with reference to fixed points at the surface. As regards (*a*), a lead must, in obedience to the laws which govern rivers, have a constant fall from its source to the lowest point of outlet. There can be no doubt as to the source of these leads, but some doubt attaches to the position of the true outlet. And the question of depth is still further complicated by the fact that, while at the sources of the leads the older gutters lie at lower levels than the corresponding newer ones, at the ends of the leads the older are at higher levels than the newer, as proved at the Surprise Mine. As regards the position of the points of outlet for these two gutters, four localities may be suggested, viz.:—

1. The Fishing Grounds.
2. Kangaroo Flat.
3. The Avoca Mine.
4. Foley's.

The deepest channel cannot have discharged itself by way of Foley's, the outcrop of gravel there being 55 feet above Kangaroo Flat. If the deep lead debouches at the Avoca Mine, it must pass under the narrow belt of basalt in portion 110, Arvid, which is scarcely probable. It is still less probable that the paltry outcrops at Kangaroo Flat, 13½ miles below the point where the lead was first struck, mark the point of discharge for a river channel which contained waterworn blocks 1 foot in diameter, at 2 miles below its point of commencement. The outcrop at Foley's may be the point of outlet for the upper channel, or may belong to a feeder flowing north-east into the trunk lead. The evidence favours the supposition that the deepest main channel underlies the principal mass of basalt, and terminates at the Fishing Grounds, at the north corners of portions 205 and 206, Arvid. Assuming such to be the case, the fall from the commencement of the lead followed that of the general surface of the country, and assuming that it ran in a straight line, a horizontal section of its bed would be a curve gradually increasing in steepness to wards the source. The course of the lead, however, being serpentine or zigzag, it follows that the fall is subject to constant variations, being steepest when the course of the lead is parallel to the greatest inclination of the country; any departure from this line will be attended with a diminution of the fall. A fair approximation to accuracy may be arrived at by drawing a line in the direction of the general fall of the country in the neighbourhood of the lead between two points on the lead of which the levels are known, *e.g.*, between the Vegetable Creek Company's old dam and Flannery's old shaft: the surface fall being in a direction west 10° north, the distance between these two points measured on this line is 125 chains, and the fall 14 feet, *i.e.*, 1 in 58. From Flannery's to Barry's, a distance of 170 chains, the fall should therefore be 194 feet, subject to some reduction to allow for the slope diminishing as the distance from the source increases. This would make the deepest channel at Barry's 80 feet below the level of the bed rock on which the present lead is being worked. This is without allowing for the diminished fall. The fall from the source to the termination of the lead at the Fishing Grounds, measured along straight lines following the principal inclination of the country, is 900 feet in $12\frac{3}{4}$ miles $=$ 1 in 74·8. Estimated at this rate Barry's gutter would still be 35 feet below Bailey's. The smallness of fall in the bottom between Hard Rock Shaft in portion 2, Hamilton, and the gutter at Bailey's (only 28 feet in a distance of $1\frac{1}{4}$ mile) also confirms the supposition that Barry's Gutter is not the main channel. Assuming that the bottom fall from the Hard Rock Shaft to Barry's is 1 in 66 (1 foot per chain) the bottom of the deepest channel here would be over 70 feet below the bed rock at Bailey's. As the gutter now has been well prospected across at Barry's from bar to bar, the conclusion naturally is that the deepest channel is between the inlier in portion 771, Strathbogie, and the north-east corner of portion 51, Hamilton.

From this supposed level at Barry's to the Fishing Grounds, a distance of 9 miles, there would be a fall of 568 feet $=$ 1 in 83·7. At this rate the bottom of the Wesley Extended Shaft, 280 feet deep, would be only 30 feet above the deepest channel, should it underlie this point. On the Geological Map aneroid levels are given at numerous intermediate points, and the approximate depth below the surface of the deepest channel, should it underlie any of these points, can be estimated from the rates given above for the different localities, viz., a fall of 1 in 66 from Flannery's to Barry's, and 1 in 83·7 from Barry's to the Fishing Grounds. From the levels given it would appear that the depth of sinking between Barry's and the south-east corner of portion 172 should not exceed 200 feet. From here to Kangaroo Flat the depth will range from 200 to 300 feet. (*b*) With regard to the underground course of the channels in the unworked areas, channels of leads flowing over basalt bottoms are so capricious in their course that any attempt to predict their whereabouts would be futile. With reference to the deepest channel between Barry's and Gordon's cultivation paddock, the deepest channel will probably be found nearer the northern margin of the made country than the southern, as the belts of basalt joining the trunk lead from the south-west probably cover tributary streams which would have had a tendency to push the main stream towards the north-west. The confluence of the Graveyard Lead, in or below Gordon's cultivation paddock, would have the same effect.

2. The probability of the gravels in the unproved country containing a fair percentage of Tin.—The richness of deep leads may be inferred

(*a*) From that of the neighbouring creeks.
(*b*) From the character of the bar rocks.

(*a*) No stream tin has been found in the claystone gullies between Flannery's and Gordon's cultivation paddock in portion 18, Strathbogie. A little stream tin is to be found in Two-mile Creek, from where it passes on to the altered claystone in W.R. 72, to its junction with the Vegetable Creek. Hogan's shallow lead, near the last point, is a guarantee that the deep country here has been fed with some tin. But below the junction with the Vegetable and Two-mile Creeks very little tin has been found in the palæozoic rocks skirting the lead. The rim rock south and west of the main Vegetable Creek Lead below Barry's is hidden by basalt as far as portion 913, Strathbogie. Here the rock is a quartz-porphyry or eurite, containing several thin veins of tin-stone, $\frac{1}{8}$ inch thick; and in portions 19 and 20 is a vein containing tin-stone, the cap of which is 10 feet wide in places. From here as far as portion 150, Arvid, the bar rock is granite and eurite, and the occurrence of stream tin in the sand at Mount Doubtful proves that these rocks are slightly stanniferous. From this point to the Fishing Grounds the bar rock is chiefly claystone, with occasional dyke masses of quartz-porphyry, but no payable stream tin has been found in the present gullies draining from them. As, however, the basalt between Strathbogie and the Fishing Grounds is over a mile wide, there may be areas of stanniferous eurite concealed under the lava and dust, especially near points of eruption, such as in portion 134, Arvid. The prospects of the richness of the lead from Bailey's to Kangaroo Flat are not therefore very encouraging. From Bailey's to Gordon's cultivation paddock, a distance of over 4 miles, as the bar rocks are barren, the richness of the lead will depend on the amount of tin drifted from the tin eurite, which ceases at Bailey's. At Barry's, 170 chains west of Bailey's, there is still sufficient tin in the gravel to make its working remunerative, provided the cost of baling is not heavy. Much of Barry's wash yielded 1 cwt. of ore per cubic yard, and the grains were fairly coarse, so that I think the lead ought to continue payable for another mile, even supposing it receives no accession of ore from the bar rocks and feeders on the south.

Near portion 15, the probable confluence of the Vegetable Creek and Graveyard leads, payable patches of gravel may be expected, but the width of basalt here is unfavourable for prospecting. Between the inlier of quartz-porphyry, near portion 19, Strathbogie, and the bar rock to the north, the basalt has a width of only 15 chains. The main channel must lie here, but if it be as narrow in proportion as the basalt, the stanniferous gravel may have all been swept out of it by the force of the current. A most favourable point for prospecting would be from the north-west corner of portion 913, in a north-easterly direction towards the north-east bar of the lead.

Produce of worked areas.—The Vegetable Creek deep leads, from their source to Bailey's, including Partridge's lead, have yielded over 6,000 tons of stream tin in a distance of 190 chains—a yield in round numbers of 31½ tons per chain = 2,520 tons per mile. At Kangaroo Flat 909 tons of ore have been won in a distance of less than ½ a mile. It may be assumed then that the produce of ore here is equal to 2,000 tons per mile, and this is probably below the true quantity, as the ground has only been partly worked. If, therefore, a yield of 2,000 tons per mile be maintained between Bailey's and Kangaroo Flat, a distance of nearly 9 miles, the quantity of ore which may be won from the unproved ground would be roughly 18,000 tons. The estimate of 18,000 tons may of course be under the true quantity, as at Kangaroo Flat one channel only, probably an upper grade, has been worked, and for reasons already stated the deep lead country here must cover two channels. It may however be the case that here, as at the Surprise Mines, the lower channel will not be as rich in stream tin as the upper.

The approximate amount of ore in the unworked ground of the main trunk Vegetable Creek Lead, the Surprise Mines, and the Y. Water Holes Lead according to the above estimates would be :—

Vegetable Creek ...	18,000
Y. Water Holes ...	7,500
Surprise Mine ...	500
	26,000 tons

This estimate does not take account of the Graveyard Lead or of Hall's Sugarloaf, for the yield of which there are not sufficient data upon which to form even an approximate estimate.

The Springs, Rocky Creek, and Ruby Hill Leads.—The basalt covering these leads is divided naturally into two portions, the eastern being separated from the western by only a few chains of coarse river gravel near the north-west corner of portion 101, Hawthorne. The two masses of lava also come within 15 chains of one another at ¼ mile east of portion 15, Hawthorne, if indeed they do not join at this point. The surface is however so entirely covered by granite sand that the question can be settled only by sinking shafts or boring. The aggregate length of these two masses of basalt is 21 miles. Although there is a slight interruption in the continuity of the basalt, there is a continuous river channel connecting the gravels underlying the lava here. The levels however prove that it is impossible for one continuous lead to underlie the whole of the made country. Aneroid measurements show the gravel at Rocky Creek and Basalt Hills to be approximately on a level with Ruby Hill, the distances between this last point and the two preceding points being respectively 7¼ and 9 miles, consequently a water-parting must occur at some point intermediate between Rocky Creek and Ruby Hill. This probably corresponds with the present main line of water-parting between the Severn and Dumaresq Rivers, which crosses the parish of Lorne in a west-north-west direction. The basalt to the south of this line, in the parishes of Lorne and Lockerby, has been termed the Ruby Hill Lead. The continuity of the Rocky Creek and Springs Leads has not yet been demonstrated.

At Rocky Creek there is evidence of powerful fresh-water action, as the gravel beds capped by basalt are from 6 to 20 feet in thickness, all the pebbles being well-rolled, the largest 10 inches in diameter. If this shingle were laid down by a river, as seems probable from the occurrence of leaves in the tributary called the "Gem," then this watercourse must have some outlet. I have not succeeded in discovering such an outlet, and cannot at present explain the phenomenon.

The Springs Lead is the name given to the belt of basalt extending in a southerly direction from the Cockatoo for a distance of 8 miles. The width varies from 20 chains to 2 miles, and, from the way in which the basalt is confined between bar rocks, there can be no doubt that it covers the site of an old watercourse, perhaps an early representative of the Swamp Oak Creek.

The main line of water-parting between the Severn and Dumaresq Rivers crosses this lead diagonally at a point 4 miles south of Cockatoo; so that, if a corresponding water-parting exists underground, the lead must be divided at this point, part flowing south into the parish of Astley, and part north by way of the Springs to "Cockatoo." I think the Springs Lead proper takes its rise somewhere near the boundary between the parishes of Astley and Athol, in which case its length would be about 6 miles. The bar rocks from this point to the termination of the lead are chiefly quartz-porphyry and granite. No stream tin has been worked in the gullies draining the bar rocks, nor have any tin veins as yet been discovered in them. The first point where an outcrop of gravel is seen is at the Springs, near the south-east corner of portion 34, Hawthorne. A tunnel has been driven into the basalt by Mr. Wheeler, which has cut gravel and sand from 1 to 2 feet thick. The wash consists of clean quartz sand, well-rolled pebbles of clear and dark quartz, black quartzite, and claystone, some of the last being 6 inches in diameter. The grains of stream tin, chiefly black, average $\frac{1}{50}$ inch in diameter. At Cockatoo, $\frac{3}{4}$ mile northerly from the Springs, in portion 30, Hawthorne, is another outcrop of coarser gravel, composed of well-rolled pebbles of quartz, chiefly dark, and blocks of quartz-porphyry and claystone, up to $1\frac{1}{2}$ feet in diameter. The alluvials at both these outcrops are just rich enough in stream tin to pay expenses, and leave a small margin for profit. The quantity of ore raised from a very small area, which has only been partly worked, is about 30 tons. The lead has been very little prospected, the surface indications being here unfavourable to the occurrence of rich gravel; though it cannot be doubted that gravel containing stream tin in small quantities underlies the greater part of the lead, and may be worked to advantage if the lead proves tolerably dry. In prospecting this lead the miner should be on his guard against mistaking the rubble of quartz-porphyry overlying the basalt for the true bed rock. This rubbling over of the lead is most noticeable near the slip-rails in the wire fence 50 chains north of the north-west corner of portion 2, Athol.

Rocky Creek Lead.—The tertiary country embraced under this name extends from Cockatoo to the water-parting between the Severn and Dumaresq Rivers in the parish of Lorne, a distance of 9 miles. There are at least two grades of gravel here, the upper grade resting on top of the basalt, 120 to 140 feet above the lower grade. Outcrops of gravel occur on this lead at Basalt Hills, Rocky Creek, near the north-west corner of portion 101, Hawthorne, at the Gem in portions 38 and 39, Lorne, and near portions 48 and 52, Lorne. The outcrop at Basalt Hills and the bottom of the channel near portion 101 are nearly on a level, while the others are from 40 to 70 feet higher. At the Basalt Hills the gravel has been tested by several shafts and two tunnels. The alluvial beds are composed chiefly of fine quartz sands such as results from the waste of quartz-porphyry (containing numbers of beryls), with pebbles of claystone up to 1 inch in diameter. The beds are 3 feet thick, containing stream tin in barely payable quantity, with colours of gold. The tin ore is black with some resin and ruby, and is coated with brown iron oxide. The grains, some of which are very sharp, average $\frac{1}{50}$ inch in diameter.

At Rocky Creek a good deal of prospecting has been done by Messrs. Colgan and others in the deep lead ground. The result of their explorations shows that the deepest ground lies in the narrow valley between the claystone hills near the north-west corner of portion 101, Hawthorne. A coarse gravel was struck here under the basalt at depths varying from 40 to 70 feet. The alluvial deposit, which was chiefly composed of well-worn quartz sand, claystone, and black felspathic quartzite, was from 3 to 20 feet thick, and yielded from 10 to 15 lb. of ore per cubic yard. The lead here has a north-west and south-east course for 1 mile, when it becomes lost under the great mass of volcanic material which has been ejected from The Gap volcanoes. Where the lead is split by the island of claystone east of portion 17, Lorne, the deepest ground probably underlies the eastern loop of basalt. A natural section of the gravels may be seen in the bed of Forest Creek. The gravels at this point are 19 feet thick. Colours of gold were got in nearly all the shafts.

The Gem Lead has been proved to be a rich feeder, falling into the main body of basalt from the north-east. The commencement is in an outlier of quartz sand and gravel, capped by basalt, in portion 38, Lorne. From here the lead has been swept away to the south for a distance of 15 chains. Then it makes its appearance again, outcropping from the north-east end of a spur of basalt. From here it has been worked by Messrs. Colgan and others for a distance of $\frac{3}{4}$ of a mile, the channel being from 10 to 62 feet wide, averaging 15 feet in width; and the alluvials consisted of pipeclay and magnesite, the former containing fossil leaves, overlying well-worn quartz sand and small pebbles of quartz-pophyry. The wash was from 3 inches to 2 feet in thickness, averaging 6 inches, and yielded 70 lb. of ore per cubic yard. The richest yield here was 3 tons of stream tin from 70 cubic yards of wash. Emeralds and sapphires are associated with this stream-tin. At Colgan's 54-feet shaft on this lead, near the south-east corner of portion 52, Lorne, an upper run of stanniferous sand and gravel was struck at 5 feet below the surface; and just east of the middle of the east line of portion 49, Lorne, a still higher level gravel was worked on a basalt bottom. This patch, which was 9 feet thick and rich in stream tin, shows at the surface for only 1 acre. The superior richness of the Gem as compared with the coarse river gravel in the trunk lead is partly explained by the occurrence of thin veins of tin-stone in quartz in portion 39, Lorne, near its commencement. Near portion 48 the outcrop shows the tertiary alluvials to have a thickness of 14 feet, the natural section showing pipeclay overlying quartz sand, which passes downwards into gravel of worn quartz pebbles, the whole being capped by hard basalt. At the outcrop, north of portion 52, similar sands yield 4 lb. of ore per cubic yard. In Salmon's shafts, 30 chains south-south-west of the south-east corner of portion 4, Lorne, worn quartz sand and subangular fragments of quartz, with a little tin, were obtained beneath rotten basalt and laterite, at 78 feet from the surface. The depth of the volcanic rock here may be inferred from the fact that in portion 35, Lorne, a shaft was sunk by Kelly and party, 207 feet deep, without reaching the bed rock.

Ruby Hill Lead.—The source of this lead probably lies near the present main line of water-parting, so that from here to its southern extremity at Ruby Hill the lead has a length of 5 miles. The width of the volcanic formation varies from 5 chains to 2 miles. The most important outcrop of gravel is at Ruby Hill, where the tertiary alluvials are from 10 to 15 feet thick and 5 chains wide. The constituents are lenticular beds of sand and gravel. In places pipeclay intervenes between the sand and basalt. The sand, which is red and white, is mostly cemented by felspathic material. The constituents of the gravel are well-rolled pebbles of clear and opaque quartz, red and black jasper, and pebbles of quartz-porphyry, the last attaining the diameter of 1 foot. Zircons and sapphires are plentifully intermixed with the stream tin. The latter is very fine, the grains being $\frac{1}{70}$ inch in diameter. It is a remarkable fact that in spite of this excessive fineness a large proportion of the grains when examined under the microscope are seen to consist of well-formed crystals with sharp edges. As no veins of tin-stone are known to occur in the rim rocks of this lead, the inference to be drawn from this is, that the horizontal and transverse sections of Section No. 8. The existence of two flows of basalt here is very apparent, and consequently there will probably be two corresponding leads. Both flows have a meridional trend, and the lava streams probably emanated from the stunted lava cones at the north-east end of the parish of Wellington Vale. The thickness of the upper sheet near this point cannot be less than between 200 and 250 feet, and that of the lower sheet about 100 feet. Outcrops of sand and gravel were observed by me at or near the northern extremity of the lead; one about 6 chains west of the north-west corner of portion 91, Annandale, a very coarse quartz gravel, pebbles being between 4 and 5 inches in diameter. As landslips appear to have occurred here, this gravel may not be *in situ.* At a somewhat higher level, in portion 91, a tunnel has been driven into the sides of the hill by Chapman and Davidson, and earthy quartz sands reached under the basalt. I was unable to obtain any tin from these sands, but they are not by any means so favourable to the occurrence of stream tin as the coarser gravel in the lower outcrop.

The third outcrop bears west 23° north from the south-east corner of portion 534, Annandale, 15 chains distant. A seam of well-worn quartz sand is seen here in the right bank of the creek, resting on a bottom of granite, and capped by prismatic basalt belonging to the older flow. As this outcrop is approximately on the same level as the coarse gravel in portion 91, Annandale, the probability is that the sand at this third outcrop is near the main and older channel. Leaves of land plants are very abundant in the clays at Bates' shaft in portion 170, Wellington Vale, and also in some shafts bearing 25 chains north-easterly from the north-west corner of portion 534, Annandale. The deep lead alluvials here are therefore probably of fluviatile origin. A water-parting probably exists underground near the present water-parting between the Mole and Glen Rivers. The shallow workings on the western side of this lead have not proved rich, having yielded up to date about 70 tons of stream tin. It must be remembered, however, that the area drained by the present Nine-mile Creek is smaller than that which discharged its water into the old Wellington Vale streams; for the volcanic material having been piled up here to a thickness of over 400 feet, the old valley must have been obliterated. The most favourable points for prospecting this lead would be:—

(*a*) Commencing from the third outcrop, and going south-westerly.

(*b*) Commencing near the south-east corner of portion 535, Annandale, and carrying on the prospecting in a direction west by north.

All this lead north of portion 66, Annandale, is well worthy of being prospected. The sinking, however, to catch the lowest channel will be deep—between 300 and 400 feet.

Surface Hill.—A small lead capped by basalt has been worked here for a distance of ¼ mile. The depth of sinking to the tin gravel was from 12 to 49 feet, chiefly through basalt. The stanniferous gravel was very coarse, some of the quartz pebbles being 6 inches in diameter. This lead appears to be the remains of an old channel, which has derived its stream tin and rolled pebbles from the higher patch of bare gravel already described. About 60 tons of ore have been raised from this lead and the adjoining gravel.

Maid's Valley Lead.—The volcanic rocks covering this lead are about 2 miles long, and from 10 to 40 chains broad. The inlier is 3 miles north-north-west of the Silent Grove tin-lodes, in claystone country. An outcrop of sand and gravel was found near the north-east corner of portion 23, parish of Gibraltar, and several shafts have been sunk, in a north-westerly direction from this point, to depths varying from 70 to 100 feet. The bottom is chiefly clay shale, but partly granite. The nature of the sinking may be gathered from the following section, commencing at the surface:—

10 feet red soil.
40 „ reddish rotten basalt.
30 „ pipeclay and sandy clay.
20 „ sand, red at top of bed, passing into white.

A great deal of black sand, chiefly tourmaline, is distributed through the lower sand and gravel beds. At Conlon's 73-feet shaft the wash was 10 feet thick, composed of fine quartz sand with well-rolled quartz pebbles, and a great deal of black sand, chiefly tourmaline, with which is associated stream tin in small quantities. Like the wash at Ruby Hill, the admixture of heavy foreign minerals, difficult of separation from the stream tin, depreciates the value of the deposit; and its great distance from the nearest known tin veins renders it improbable that anything more than barely payable deposits will be found under these volcanic hills.

Probable yield of the deep leads.—The small and imperfectly worked areas on the deep leads do not afford sufficient data for making even an approximate estimate of the amount of ore contained in the far larger unproved portions of the lead. If I may be allowed to hazard a conjecture, the quantity of workable ore at the lowest estimate will be not less than 50,000 tons. The absolute quantity of ore contained in the deposits would of course be far greater.

TIN LODES.

Ore deposits of this class in the Vegetable Creek district may be ranged in eight groups, as follows:—

First group	Gulf lodes	11
	Yankee lodes	3
	Somers' lodes	2
	Blair's lode	1
	Stilbite lode	1
	Graney's lode, &c.	4
	Gap lode	1
Second group	Heiser's lode	1
	Paradise lode	1
	Flagstone lodes	2
	Silent Grove lodes	5
Third group	Black Swamp lodes	2
Fourth group	M'Donald's lodes	3
	Butler's lode	1
	Nuggety lode	1
	Lode in portion 131, Highland Home	1
	Mount Pleasant lode	1
Fifth group	Lode and stockwork in Strathbogie paddock	2
	Lodes at Hall's Grampians	2
	Curnow's lode	1
	Dutchman lodes	2
	Howe's lodes	2
	Geyser lode	1
	Speare's lode and branch of Torrington	1
	Main Torrington lode	1
	Thomison's lode	1
Sixth Group	Taylor's lodes, Glen Creek	3
	Wallaroo lode	1
	Fergusson lode	1
	Amethystine quartz lode	1
	Reid and Crane's lode	1
	Lee's Gully lodes	7
	The Cliff lode	1
	Davy's lodes	3

Seventh group	Stockwork in Wesley's, Fox's, and Griffith's and Hammond's ground, near Emmaville	1
	Stockwork in Hall's paddock	1
	Stockwork, portion 236, parish Strathbogie North	1
	” ” 43, ” ” ”	1
	” ” 540, ” ” ”	1
	” ” 253, ” ” ”	1
	Bath's lode in portion 116, parish Scone	1
	Lodes in portions 3 and 4, parish Tent Hill	2
	M'Master's lode	1
	O'Donnell's lode	1
	Ottery lodes	4
Eighth group	Folkestone lode	1
	Planet lode	1
	Lode in portion 122, parish Wellington Vale	1
	Total number of veins and stockworks	90

With the exception of a few thin veins of tin-stone, $\frac{1}{3}$ inch thick, in portion 39, parish Lorne, county Arrawatta, no veins of tin-stone have been found east of the Gulf lodes in the Vegetable Creek District.

GULF LODES.

1. *Gaden's Lode*, the furthest west of the above-mentioned lodes, is situated in portion 33, parish of Muir, county Gough. The vein is from 2 to 3 feet wide, and strikes 40° east of north and west of south, dipping about 82° south-easterly. Veinstone chlorite and quartz with vughs filled with purple fluorspar. The walls are not defined, the veinstone merging into a very quartzose ternary granite, becoming less quartzose at a distance from the vein. Shaft sunk on vein 24 feet deep.

2. In portion 27, in the same parish, is a thin vein of quartz and tin-stone, now hidden under rubble, striking 43° east of north and west of south.

3. *Red Cross Lode*, in portion 18 in the same parish, strikes 43° north of east and south of west, dipping 85° north-westerly, average width 2 inches. The vein consists of nearly solid tin-stone, replaced occasionally by quartz and chlorite. The tin-stone is black, deep red, resin, and translucent. The ore at the centre of the vein is coarsely crystalline, but becomes finer towards the walls. The foot-wall shows faint slickensides. The vein is encased by hard quartzose granite. At the bottom of a shaft on the vein, 35 feet deep, the vein was 1 foot in width.

4. In portion 19 in the same parish are two veins. The north vein strikes 40° east of north, dipping north-westerly, 3 feet wide in places. Walls not well defined; country hard granite; shaft 20 feet deep; vein at bottom of shaft carrying ore.

5. 2½ chains south of preceding, a vein strikes 39° east of north; average width of tin-bearing veinstone, 3 inches; vein, nearly vertical, composed of quartz and tin-stone in open-grained granite porphyritic by felspar.

6. The Gulf Stream Company's lodes are situated in portion 23, parish of Muir, county Gough, and in portions 59 and 60, parish of Land's End, and have produced over 270 tons of tin ore.

In portion 23, parish of Muir, a vein of chlorite and quartz, part of the main vein, has been mined for a distance of 34 yards. A shaft sunk at the point shown on fig. 6* struck a shoot of ore at a depth of 40 feet from the surface. The shoot, which was from 4 to 5 feet in vertical measurement, and about 10 inches wide, dipped aslant the plane of the vein in an easterly direction, 20 feet vertically in a horizontal distance of 49 feet, producing 7 tons of ore. The main body of ore was worked in portion 60, parish of Land's End, county Gough. The veinstone, in places 8 feet thick, averages 2 feet in width, consisting of chlorite quartz and decomposed white felspar; strike, 1° south of east and north of west; dip, 72° northerly.

*See accompanying plan.

A remarkable shoot of ore has been worked here for a distance of 3½ chains. The shoot commences at 8 feet from the surface, and was found to dip east gradually for a distance of 10 yards, where it pitched down at a steep angle. At 12 yards from the point of commencement, and 40 feet below the surface, the shoot was split by horse of granite, part of the vein branching off in a direction west 35° north. Going east from this point a very rich course or shoot was struck, perhaps a continuation of the preceding. The top of this shoot was 15 feet below the surface; the shoot itself was 15 feet deep, 127 feet long, and from ½ to 8 feet wide, producing in that space 229 tons of tin-stone, at the rate of 16¾ cwt. per cubic yard.

Two more shoots were cut in this shaft, as shown in figure 6; the middle one at 120 feet from the surface, measuring 18 in. × 10 in.; and the lower at 172 feet, being 3 feet deep, and from ½ foot to 2 feet wide. The tin-stone in all these shoots occurs freely crystallized or massive in chlorite and

*See ac
ing pla

8. In portion 131 in the same parish, a vertical vein of chlorite and quartz with a little tin-stone, from 3 to 4 inches wide, strikes 42° east of north and west of south, dipping south-easterly; shaft 60 feet deep.

9. North of preceding vein in the same portion, a vein of quartz and vesuvianite, from 4 to 5 inches wide, striking 36° north of east. The vesuvianite lies principally on either side of the quartz between it and the walls of the vein. The granite is jointed south 40° west. This and the preceding vein are on the line of strike of the "Gulf" cross-veins.

10. In portion 31, in the parish of Land's End, are two veins of quartz and tin-stone, each 1 inch thick, separated from one another by felstone, 10 inches wide. Strike, 42° east of north and west of south; veinstuff, quartz, soapy, green chlorite, and white mica with a little tin-stone. A shaft has been sunk on the vein to a depth of 35 feet.

11. North of the preceding vein, in the same portion, a thin vein of quartz and chlorite, containing tin-stone, strikes north-east and south-west dipping at a steep angle south-east. The veinstuff passes gradually on each side into the enclosing granite.

12. *Yankee Veins.* Three principal veins, so called, worked in portion 99, in the same parish, may be distinguished as west, middle, and east. The west vein, averaging 1 foot in width, strikes 44° east of north and west of south, dip north-west, nearly vertical. Veinstuff consists of quartz, chlorite, and tin-stone, and is tin-bearing for a width of 2 inches. Walls not defined; shaft 20 feet deep.

13. *Middle Vein*, from 1 to 1½ feet wide, strikes north-east. Veinstuff similar to preceding. Tin-stone occurs in large beautifully-formed crystals in the quartz, and is distributed through the vein in the form of a shoot, pitching easterly. Shaft 20 feet deep; yield, 6 tons of ore.

14. *East Vein*, averaging 1¼ feet in width, strikes 35° north of east and south of west, and has been traced on the surface for 4 chains. In a shaft sunk on the reef near Wilcox's garden, at 15 feet from the surface, a large vugh was found 2 feet long, 2 feet deep, and 1½ feet wide, the sides being lined with magnificent crystals of tin-stone and clear quartz. In some specimens the tin-stone invests the quartz, while in others it is enclosed in it, showing that the silica and tin must have been in solution simultaneously.

18. In portion 90 in the same parish a vein strikes 14° south of east, dipping 73° northerly; veinstuff, quartz, felspar, and a variety of red stilbite, resembling heulandite. A shoot of tin-stone in heulandite, from 1 to 3 feet wide and 4 feet deep, was followed down from the surface to a depth of 20 feet for a horizontal distance of 9 yards, producing 3 tons of ore. The shoot pitched easterly. This vein strikes almost direct for the Gulf main vein.

19. Near the south-west corner of portion 92, in the same parish, is a vein of solid tin-stone in very hard aplitic granite, close to the boundary of the claystone. Strike 35° east of north and west of south. At Hamilton's shaft in the same portion, 25 feet deep, a shoot of ore was found on the strike of this vein 1 foot wide and 2½ feet deep, pitching to the north-east. Veinstone, white felspar; yield, ½-ton of tin-stone.

20. Graney's pipe vein in portion 53, in the same parish, may be described as a carbona or impregnation of the "flattened sausage" type. The shoot of ore was cylindrical or oval. The general dip is 20° south of east. The dip varied from the surface downwards as follows:—

0—20 feet 20° north of east and south of west at 55°
20—50 „ 5° „ „ „ 45°
50—60 „ Vertical

At 20 feet from the surface, where the shoot was largest, it measured 5 feet by 2 feet. At the bottom of the shaft the ore was seen to occur freely crystallized or massive, in a veinstone of white felspar chlorite and quartz, which followed a crack in the granite. No trace, however, of this crack could be seen at the surface, the granite being closely jointed in a direction 30° east of north and west of south, and being very hard. The sinking cost £6 per foot; the yield of ore was 4 tons. The nature of this pipe vein is shown on figure 7.

23. *Gap vein,* between portions 163 and 165 in the same parish, strikes 13° degrees north of east and south of west, dipping northerly at 80°. The vein is from 2 inches to 1 foot in width, composed of tin-bearing quartz enclosed in soft ternary granite, porphyritic by orthoclase. The walls show distinct slickensides. Yield; 2 tons of ore.

Fig. 8* shows the relation between the occurrence and strike of some of those veins and the neighbouring junction line of the claystone and granite.

*See accompanying plan.

SECOND GROUP.

24. *Heiser's vein* in portion 68, in the parish of Flagstone, in the same county, strikes from 15° to 20° east of north. The lodestuff is a greisen composed of chlorite and quartz, in hard quartzose granite porphyritic by orthoclase, and containing schorl. Shaft about 30 feet deep.

25. *Paradise vein.* A shaft has been sunk 95 feet on this reef, at a point 6 chains east of the north-east corner of portion 54, in the same parish. Strike 35° east of north and west of south. The cap of this vein at the surface is over 30 feet wide, composed of chlorite and quartz, and coloured a deep reddish-brown from the oxidation of the iron in the chlorite, and of the iron pyrites contained in the veinstone. The veinstone is principally chlorite, quartz being distributed through the latter in imperfectly formed crystals, and in small drusy veins. Iron pyrites occurs in well-formed pentagonal dodecahedrons and cubes in the veinstone, associated with mispickel. The actual width of the vein is about 10 feet. Tin ore is said to have been found in the veinstone, but I could not see any in the spoil bank round the shaft, and the sides having fallen in I was unable to examine the vein below the surface. That this large body of veinstone will make into tinstone at a depth seems probable, as the vein bears directly towards Cadell and Hall's tin veins, 4½ miles distant. This vein is worth further prospecting.

26. *Cadell's veins* in portion 10, parish of Flagstone, comprise two veins of quartz and tinstone striking 35° east of north and west of south, averaging ¾ inch in width. These veins swell out in places into lumps of solid tinstone 16 inches wide; the granite is hard, euritic, and fine grained. These veins appear to be joints in the granite, the ore being chiefly concentrated towards the middle of the joint as well as freely crystallized into its sides.

27. *Cadell and Hall's vein* in portion 6 in the same parish, strikes about 10° north of east and south of west; the vein is composed principally of eurite traversed by "blows," and veins of quartz, with a little tourmaline and chlorite. In the latter the ore occurs massive in veins and vughs, while in the former it presents the appearance of small crystals peppered through the eurite. The ore occurred principally in a shoot extending vertically for 12 feet, when it became nipped. The surrounding granite is porphyritic by quartz and orthoclase felspar.

28. *The Silent Grove veins* are five in number. In portion 15, parish of Silent Grove, County Clive, are two nearly parallel veins; the north vein strikes 15° south of east and north of west, dipping northerly. Width, 13 inches; veinstuff, quartz, felspar, chlorite and mica, with tinstone and bismuth. The tin lies next to the hanging wall for a thickness of 9 inches; the remaining 4 inches of veinstuff contains the bismuth, the latter occurs native, and as sulphide, in acicular crystals radiating through the quartz, and near the surface as an earthy oxide. At 25 feet from the surface the bismuth became entirely replaced by tinstone; the strike of this vein coincides with that of Burns' bismuth vein 10¾ miles south-south-east.

29. One chain south of the preceding, a vein strikes 20° south of east and north of west. The vein stuff, including the granite infiltrated with vein material, is at least 6 feet wide, and consists of tin-bearing rotten felspar, 1 foot wide, passing into a quartzose felstone, containing chlorite. The vein has not defined walls. The ores are tinstone and arsenical pyrites. The former runs in shoots through the veinstuff from 8 inches to 10 inches wide, pitching about 30° in an easterly direction. The country is a fine grained quartzose felstone, containing chlorite.

30. The vein which has been most prospected here strikes through portions 12 and 13 in the same parish. South of the main shaft, 75 feet deep in portion 13, the vein strikes 31° east of north and west of south for a distance of 4½ chains, while north of the same point it bears 28° east of north and west of south for a distance of 8 chains, dipping south-east.

The veinstone is chiefly cellular quartz, mica, and chlorite with tinstone, magnetite, and manganese. In places the quartz is coloured pink by a silicate of manganese resembling rhodonite.

The tinstone occurs in bunches of solid ore 3 inches wide in places. The casing is a hard quartzose granite.

Ten tons of ore were crushed from this vein.

31. Three-quarters of a mile south-east of the preceding, in portion 71, in the same parish, are two parallel running veins. The west vein strikes 30° east of north and west of south, dipping north-westerly; is from 1 to 2 feet wide, and contains tin-stone in friable quartz. A shaft has been sunk on it to a depth of 40 feet.

32. Twelve yards south-east of the preceding is a second vein, from 1 to 4 feet wide, striking 30° east of north and west of south, underlying north-westerly.

The tin-stone occurs in felspar and cellular quartz, either in bunches or in small crystals disseminated through the mass of the veinstone.

A shaft has been sunk on the vein, 50 feet deep.

Fourteen tons of ore have been won from the last two veins.

THIRD GROUP. BLACK SWAMP VEINS.

These veins are situated in the parish of Rockglen, county Clive.

There are two principal veins here which may be distinguished as the west and east veins.

33. The east vein commences in portion 405, as a small tin-bearing quartz vein with a little mica, 3 to 4 inches thick, striking about 30° east of north and west of south.

Near the south-west corner of portion 408 a shaft has been sunk 43 feet deep, on an irregular vertical vein of quartz, striking 40° east of north and west of south. The quartz veinstone is separated from the granite by a soft white micaceous clay 1 inch thick. A small shoot of ore was said to have been got at 20 feet from the surface.

The vein did not appear to be tin-bearing at the bottom of the shaft.

The same vein has been picked up again near the south-west corner of portion 397, in the same parish.

At the south shaft here, 20 feet deep, the vein strikes 40° 30′ east of north and west of south, having an average width of 8 inches.

The veinstone is a hard quartz, replaced by tinstone occasionally, and traversed by a central crack, on either side of which the quartz passes into a quartzose granite, containing dark mica, and slightly porphyritic by orthoclase.

The granite, which is traversed by dykes of eurite, proved soft to a depth of 12 feet, when it became very hard.

Near the bottom of the shaft was a shoot of solid tinstone 4 feet long and 8 inches wide.

At 38 yards further along the vein, in a direction 38° east of north and west of south, the vein was proved to be from 2 inches to 2 feet wide, composed of greisen, quartz, chlorite and muscovite, the tinstone occurring chiefly in minute vughs.

From between the next two shafts to the north-east, 8 tons of ore are said to have been won in a horizontal distance of 20 feet, at a depth of from 18 to 20 feet below the surface.

At the north shaft in the same portion, 12 feet deep, the vein consists of porous black glassy quartz, poor in ore, from 1 to 2 feet wide.

34. Three and a half chains easterly from the last point is the east vein, coursing 42° east of north and west of south, with a slight underlie north-west. The vein has been proved for a horizontal distance of 45 yards and to a depth of 15 feet. Average width, 1½ foot. Veinstone friable cellular quartz with nests of tourmaline and chlorite, small bunches of tin-stone, and a little wolfram. The country is similar to that enclosing the preceding vein, but softer. Sixteen chains north-north-east from here, near the southern north-east corner of portion 402, parish of Rockglen, a vein, possibly a continuation of the last vein, strikes 26° east of north and west of south, is nearly vertical, and varies in width from ½-foot to 1 foot. Veinstone, quartz, felspar, and pearly chlorite and mica.

In portion 401, in the same parish, a small cross vein ½ foot to 1 foot wide, strikes 25° north of east and south of west.

In portion 165, in the same parish, a thin vein of quartz and tinstone strikes 26° east of north and west of south. A shoot of ore has been worked here 6 feet long and 5 inches wide. The ore was pinched at the upper and lower end of the shoot, the continuation of the vein being marked by a thin vein of quartz, filling a joint in the granite. The vein has been traced for 5 chains towards the north-north-east. One ton of ore was obtained from the preceding shoot in an excavation 8 feet deep and 6 feet long.

FOURTH GROUP.

Macdonald's veins on the Glen Creek comprise a number of thin veins, three of which will be described.

35. In portion 5, parish of Paradise North, county Gough, 1 chain south of the north-east corner of the portion, three thin veins of tin, bearing quartz $\frac{1}{4}$ to $\frac{1}{2}$ inch in width, strike 15° north of east and south of west, intersecting a hard fine-grained schorlaceous granite. The dyke mass is traversed by a number of thin seams of schorl.

36. In portion 2, in the same parish, at the point where the southern body of veinstone is shown on the geological map, are 4 thin tin-bearing veins of quartz and tourmaline within a space of 6 feet, striking 15° north of east and south of west. Where the veins outcrop near the top of the hill the dip is chiefly southerly, but lower down towards the Glen Creek, the dip is 82° northerly. These veins are from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inch thick, and consist of quartz, felspar, and schorl, with tinstone, copper pyrites, and fluor spar. The walls of the principal vein show distinct slickensides. The tin-stone occurs in nests and strings associated with the schorl. The pink schorlaceous granite forming the casing is fine-grained quartzose, and very hard. The vein has been worked for a length of 2 chains.

37. Forty yards north of the preceding a felspathic vein containing fluorspar and oxides of iron and copper, strikes about 20° north of east and south of west, dipping northerly. Scheelite has lately been discovered in this locality.

The payability of these veins depends on their becoming united at a depth to form a vein of workable width. That such a union, if it takes place at all, must be at a great depth below the surface, is evident from the natural section afforded by the banks of the Glen Creek. From the highest point of outcrop of these veins down to the point where they are intersected by the Glen Creek, there is a fall of nearly 200 feet in a distance of 15 chains; and throughout the whole of this distance the veins maintain an approximate horizontal and vertical parallelism towards each other, showing little variation in thickness. The question as to whether the veins penetrate the eruptive diorite (diabase?) west of the schorlaceous granite has not yet been proved.

BUTLER'S VEIN, &c.

Three miles north-east from Macdonald's veins, and striking towards them, are "Butler's" and "Nuggetty" veins.

38. ***Butler's vein*** has been traced for a distance of 1 mile through portions 173, 174, and 307, parish of Highland Home. The Alexsteane Gully, on the east side of which the vein is situated, is hemmed in by somewhat precipitous sides of rugged granite. The vein has however now been made accessible by road from Emmaville. The vein at the point where it leaves the bottom of the gully strikes up the sides of a steep hill in a direction varying from 26° to 32° north of east and south of west. At 10 chains in a north-easterly direction from its point of commencement the vein is split into two branches. At 2 chains further the east branch becomes split again, the right offshoot extending at least 16 chains before it dies out. The left after becoming divided into three, rejoins the west branch at three points within a distance of 10 chains from the second split. A large "horse" of granite is thus enclosed between these branches 20 chains long and 4 chains wide. At 2 chains north-easterly from the north-east end of the "horse" the main vein is lost for 1 chain, then reappearing can be traced for 12 chains striking 32° north of east and south of west. At the end of this distance the vein becomes split again, the east branch dying out in 7 chains, while the west continues with some variation of strike for a further distance of 28 chains. [For plan, see accompanying geological map.] The average strike of the vein is 35° north of east and south of west. The dip is north-west, varying from 72° to 85° The thickness varies from 2½ feet to 10 feet, averaging 3 feet 2 inches. The vein was being systematically opened up from its south-

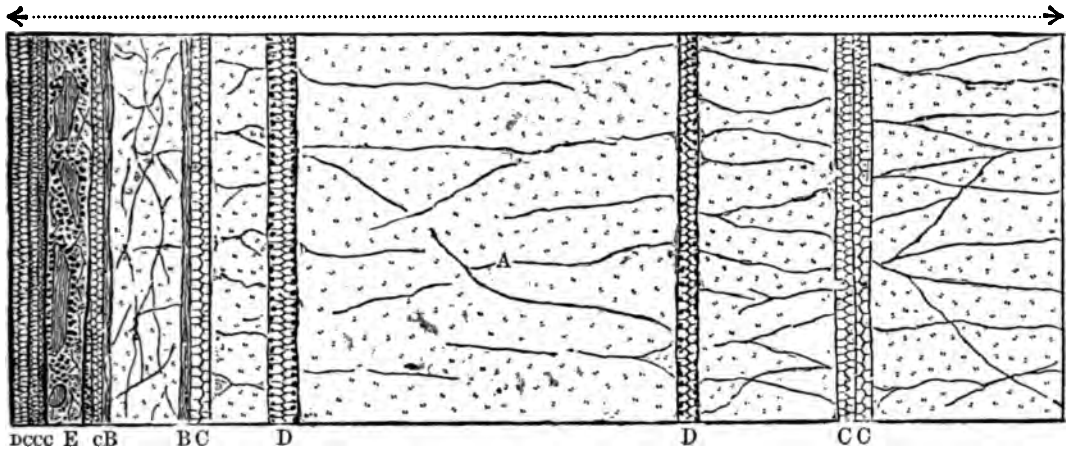
west end for a distance of 10 chains by Butler's Tin-mining Company. An adit was being carried from this point, about 30 feet above the level of the creek along the course of the vein, and three shafts and one winze were being sunk to meet the adit, while the vein was being further tested by three surface cuttings. At 22 yards from the mouth of the adit the vein is 4 feet wide. The casing is eurite, passing into coarsely crystalline porphyritic granite. A vein of quartz joins the main vein at this point, striking 10° east of north and west of south. At the end of the tunnel, 150 feet long, the vein is 2½ feet wide, the centre consisting of quartz 1 foot wide, passing at the sides into chloritic quartz, which graduates into granite on the hanging wall. The footwall is fairly well defined, and shows slickensides. At 44 feet below the level of the adit, and 77 feet from its commencement, a considerable quantity of water was met coming from the vein, which here dips 85° north-west, the country being fairly soft. In the open cutting, at which the winze (46 feet deep) was being sunk, a shoot of ore was cut pitching to the north-east. The lodestuff in the face of the cutting was 10 feet wide. The tinstone occurs in seams and bunches, freely crystallized in chloritic quartz.

At No. 2 shaft, 68 feet deep, the vein, at least 6 feet wide, is fairly rich in tinstone, dipping 85° north-west, and showing a good hanging-wall, but no foot-wall.

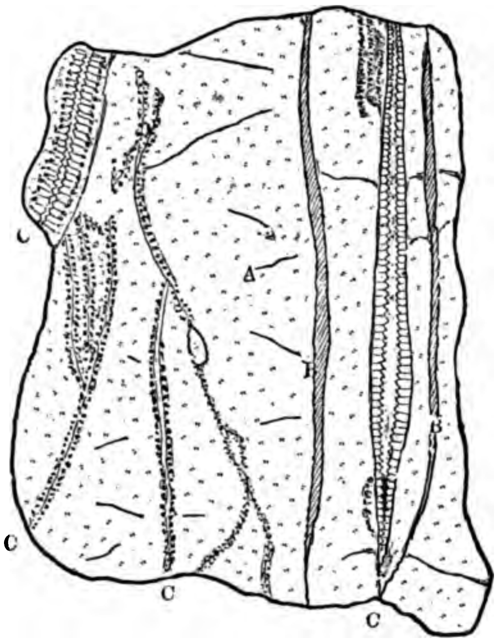
In No 1 shaft, 42 feet deep, the vein, 3½ feet wide, has a fairly well-defined foot-wall, but no hanging-wall, and dips 67° north-west. The veinstone is a rather porous quartz, passing at the sides of the vein into a quartzose granite. The tinstone occurred principally in the form of a shoot, 1 foot to 1½ foot wide, and about 6 feet long, pitching at the rate of 1 in 4. A little galena and blende are associated with the tin ore. The character of the vein at this point is shown on the accompanying Figure 9:—

FIG. 9.

10 feet.



A. Quartz and chlorite.
B. Chlorite.
C. Barren comby quartz.
D. Tin-bearing comby quartz.
E. Quartz and chlorite enclosing fragments of chlorite veinstone, the latter invested with tin crystals.



Scale—1 inch equals 1 foot.
Section across part of the Mount Pleasant vein, probably a continuation of Butler's.

A. Quartz and chlorite.
B. Chlorite.
C. Comby quartz with tinstone, and veins of tinstone traversing the mass of the veinstuff.

In portion 174, in the same parish, at 5 chains easterly from the first split in the vein, a trench on the left branch proves it to be 4½ feet wide, and shows that the veinstone is composed of quartz and chlorite, with a seam of nearly solid tinstone ½ inch wide next the south-east wall.

At Ottery's workings on the left branch, the vein, 3 feet wide, contains three seams of tinstone, having an aggregate thickness of 1½ inches. A cross-course, filled with clay flucan, has moved the vein here a few feet north-east.

At Ottery's 24-feet shaft, 123 yards further along the vein, the vein is 3½ feet wide, and tin-bearing for a width of 1 foot 8 inches, the tin being freely crystallized in drusy cavities in the veinstone, or in solid seams, chiefly following the smaller quartz veins traversing the mass of the lodestuff. The vein here dips at 72° north-west, and has a well-defined foot-wall showing slickensides. Horizontal joints, or "floors," composed of gossany chlorite and clay, and not tin-bearing, cross the vein at intervals of about 2 feet, the vein being impoverished where they are most frequent. The surrounding granite consists of coarsely crystalline quartz, felspar, and dark mica, occurring in patches in a more finely crystalline masses of a similar rock. The whole is traversed by veins of eurite bearing east and west.

Bell's vein is a continuation of the same vein beyond Ottery's. The vein here is from 2½ to 3 feet wide, containing more blende than tinstone, and bears 32° north of east and south of west, dipping north-westerly. The absence of conformity between the strike of this vein and that of the joints in the surrounding granite, the occurrence in the vein of branches and horses, as well as the evidence of the fissure having been reopened in places, prove this vein to be a true fissure vein. The most favourable point for further testing the vein appeared to me to be the west side of the great horse. The vein is tin-bearing here, and if the shoot extends to where the branches unite underground a good body of ore may be expected.

39. *Nuggety Vein.*—In portion 178, in the same parish, is a vein of chlorite or quartz, 3 to 6 feet wide, striking from 22° to 26° north of east and south of west. Tinstone was visible only in loose surface specimens.

40. In portion 131, Highland House, are three leaders, 200 yards north-west of the south-east corner of the portion, striking 40° east of north and west of south.

41. *Mount Pleasant lodes.*—In portion 122, parish of Rockvale, county Clive, is a reef striking 26° east of north and west of south dipping at 83° in a north-westerly direction. The width varies from ½ foot to 2 feet 6 ins., the average width being 1 foot. The lodestuff is friable-porous quartz and chlorite. The structure of the veinstuff suggests that the fissure after being filled with chlorite and quartz was partially re-opened, the new cracks being lined with white silica and tinstone, as shown in the lower diagram, Fig. 9. This vein much resembles Butler's, which lies 3½ miles to the south-east, but the strike of the latter vein is towards a point somewhat to the east of the Mount Pleasant vein.

42. In Strathbogie paddock, in portion 20, parish of Strathbogie, county Gough, a vein strikes 15° east of north and west of south, the cap being from 6 feet to 10 feet wide. The veinstuff is a chloritic felstone, with strings of quartz containing tinstone and mispickel. The casing rock is felspar-porphyry. The vein has not yet been prospected, but is worth testing. One mile south, in the same portion, a strong outcrop of gossan marks the prolongation of this vein in that direction.

43. In portion 19 in the same parish, are several thin veins of tinstone and brown iron ore, ⅛ inch thick, striking from 10° to 30° east of north and west of south, apparently converging towards the south. The country is felstone, containing chlorite and hornblende.

44. "*Hall's Grampians.*"—In portion 95, in the parish of Strathbogie North, in the same country, several thin veins of tinstone and quartz strike 35° north of east and south of west. The veins are nearly vertical, from ¼ to ¾ inch thick. The country is a thickly-cleaved highly-altered claystone, almost a felstone in places.

45. In portion 101 in the same parish, a vein from 2 to 3 feet wide strikes 27° north of east and south of west, underlying north-westerly. The veinstone is a friable cellular quartz containing arsenical pyrites, tinstone, and wolfram. This part of the hill for a length of ¾ of a mile and a width of ½ a mile is a perfect network of minute veins of quartz and tin ore, the veins following the cleavage of the claystone.

46. In the parish of Highland Home, county Gough, Curnow's vein strikes 40° north of east and south of west, dipping 85° north-westerly. The

vein is from 2 to 6 feet wide, averaging 3 feet, and has been traced along the surface for 18 chains. The veinstone is quartz and chlorite, with tinstone well intermixed. A shaft has been sunk on the vein to a depth of 200 feet. At 104 feet from the surface an easterly drive along the vein proved that the vein became contracted to a thickness of 2 feet, at which point it ceased to be tin-bearing; and the same was experienced in a westerly drive 28 feet long at the same level. At 130 feet from the surface the vein was tunnelled 35 feet west and 40 feet east, and was 6 feet wide at the shaft and 3 feet at the ends of the drives, and still tin-bearing. The contiguous granite is fairly soft, and contains geodes of felspar.

47. The vein known as "No. 1 Dutchman" strikes through portions 165, 166, and 167, parish of Highland Home, in a direction 34° 30′ north of east and south of west for 10 chains, then 38° 30′ for 12 chains, the vein having been traced on the surface for a total distance of 22 chains. The dip is 81° north-westerly, but the vein is vertical in places. The width varies from 3 to 6 feet, averaging 4 feet. The foot and hanging walls are well-defined, and show slickensides, and the granite casing is soft. The veinstone is principally quartz, with some chlorite. Two levels have been driven along the vein from its south-east end, the upper 70 feet long, and the lower 240 feet. The end of the lower tunnel is 70 feet below the surface, there being 44 feet of unworked vein between the two levels. At the mouth of the lower level the vein was split by a "horse" of granite, which increased in width to the north-east. At the end of the upper level the ore was chiefly distributed through a vein 1½ feet wide on the south-east side of the "horse," and went to the foot-wall, which was well-defined. Several cavities were met with in the vein, 1 foot in diameter, lined with beautifully-formed crystals of clear and smoky quartz, 8 inches long, enclosing crystals of tinstone. 1,500 tons of stone were to grass ready for crushing at the time of my visit.

48. No. 2 Dutchman strikes through portions 4A, 3A, and 2A in the same parish, in a direction 28° east of north and west of south. The vein is 3 feet wide, and tin-bearing for 1½ foot. In portion 2A the vein becomes split into two branches, the south branch striking 38° north of east and south of west, and the north 35° east of north and west of south. Over 180 tons of veinstone have been raised from this reef. 130 tons crushed yielded over 10 tons of tin ore. The average yield of the total amount of ore crushed at these mines at the time of my visit was 3¾ per cent. of tinstone.

Howe's Veins, in portion 266, in the same parish, are continuations of the Dutchman. Out of four veins found here, the positions of the two principal ones are shown on the Geological Map.

49. The northern vein strikes 40° north of east and south of west, and is from 2 to 3 feet wide.

50. The southern varies in its strike from 40° to 45° east of north and west of south, dipping 64° south-easterly. This vein is from 3 inches to 15 inches wide, composed of quartz and chlorite, the foot-wall being well-defined, and showing slickensides. The country is a fine-grained granite. The vein has been trenched to a depth of 10 feet, yielding 3½ tons of tin ore. Two and one-half miles north-easterly from the preceding are the Torrington veins, situate in the parish of Annandale, County Clive. These mines are situated on flat topped granite hills with open swampy grass flats, with belts of timber and scrub, forming the water-parting between the Mole River and the Glen Creek. Being on the line of water-parting, these mines are entirely dependent on dams for their water supply. These veins appear to be ranged in two main lines 1. The Geyser, Speare's, the main Torrington vein with its branch vein, and the continuation of the Torrington (?) vein, near the north-east corner of portion 543. 2. Thomison's vein, in portions 1A and 541, and a parallel vein 1 chain south-east. The country is a coarsely crystalline granite, composed of triclinic and monoclinic felspar with abundant dark mica quartz, and a little muscovite and hornblende. Near the north-east end of the main vein the granite is fine grained and intersected by veins of eurite, which latter frequently forms one of the walls of the vein. The eurite strikes about 5° west of north and east of south, and is jointed chiefly 40° east of north and west of south. The average strike of the vein is 36° north of east and south of west. The veins consist of fine grained felstone or eurite, fairly soft from the surface to a depth of from 30 to 40 feet, when it becomes very hard. In some cases the veinstone is separated by a sharp line from the granite country, while in others it merges gradually into that rock. Tin-stone occurs in disseminated crystals or thin strings in the felspathic veinstuff, generally running in shoots or floors, the ore being partly black and partly resin; while some of the crystals are quite translucent.

51. *The Geyser vein*, in portion 500, parish of Annandale, strikes 37° north of east, and south of west, and is almost vertical, averaging 11 inches

wide. The tin ore occurs in a thin solid seam next to the hanging-wall, having for a foot-wall a dyke of eurite 1 foot wide; it also runs in shoots through the eurite. The deepest shaft is 74 feet, the vein at the bottom being 1 foot wide; but as the shoots became exhausted at this depth further sinking was discontinued.

52. *Elliott's vein* in Speare's portion 2A, parish of Annandale, and 149, parish of Highland Home, a continuation of the preceding vein, strikes 35° north of east and south of west, is nearly vertical, and averages 9 inches in width. Six tons of ore have been won from this vein, which averages 1½ cwt. of tinstone per cubic yard of veinstuff.

53. The north-west branch of the main Torrington vein in portion 541, in the parish of Annandale, strikes from 21° to 23° north of east, and south of west, being a continuation of Speare's and of the Geyser. At 92 yards along its strike from its south-west end, the vein joins the main Torrington vein. A shoot of ore has been worked out of this branch vein, commencing near the surface at the point of junction, in a south-west direction for a horizontal distance of 120 feet, in which distance the shoot dipped 40 feet. The main vein from the point where the branch leaves it has been worked for 34 yards south-west and 66 yards north-east; the strike is 42° 30′ north of east and south of west, the dip being 74° south-east. At its north-east end the vein is shut off abruptly against a dyke mass of euritic granite, striking 5° west of north and east of south. A rich shoot was worked here from near the surface to a depth of 135 feet. The shoot pitched 40° east of north and west of south, at an angle of 45°, and was 2 feet wide where widest, averaging 10 inches. The hanging-wall was well defined. In part of the workings an intrusive dyke of eurite formed the foot-wall of the vein. Close to where the cross course of eurite intersects the vein a bunch of ore was got out of 64 cubic feet of veinstuff, weighing 13 tons. At the north-west corner of portion 543, in the same parish, is a vein considered to be a continuation of the main vein heaved to the south-east by the cross course. The strike is 36° north of east and south of west, the average width being 8 inches. The veinstone is felspar, with tin crystals. The country is a very hard fine grained micaceous granite. The total amount of ore won from the Geyser, Elliott's, and the Torrington veins, up to the end of 1884, was over 70 tons.

by claystone. The greisen is composed of quartz and pearly chlorite or greenish mica. The tin-stone runs in floors and pockets in the veinstuff, generally massive, but also in well formed crystals half an inch in diameter.

56. In portion 71, in the same parish, a vein from 1 foot to 1½ feet wide strikes 10° degrees north of east and south of west. The veinstuff, which is felspathic and of a greenish colour, with scales of lepidolite, contains small well formed crystals of tin-stone.

57. In the same portion, north of the preceding vein, is another vein 1 foot wide, striking 21° north of east and south of west. The vein consists of quartz and mispickel with molybdenite and probably bismuth. The casing is claystone. This locality is very promising, and is worthy of being prospected, especially near the main gossany vein (No. 55).

58. *The Wallaroo vein* has been traced for a distance of 1½ miles through portions 170, 169, 171, 302, 301, 300, and 304, parish of Highland Home, county of Gough, and is probably a continuation of one of Taylor's veins. The vein has been worked at intervals for a distance of 6 chains, and to a depth of 25 feet. The vein strikes from 40° degrees east of north and west of south to 40° north of east and south of west, the latter is the normal strike. The change of bearing is due to the vein being heaved northerly. The dip is 60° south-easterly. The vein is from 1 foot to 4 feet wide, averaging 1½ feet. The vein consists either of a central crack, the sides of which are lined with veinstuff merging into granite, or of a veinstone enclosed between well defined walls. At the north-east end of the workings the vein has good foot and hanging walls showing slickensides, the veinstone being separated from the hanging-wall by a selvage of clay flucan, 1 inch thick. The surrounding granite which is fairly soft, is slightly porphyritic by quartz, and consists of quartz, biotite, orthoclase, and triclinic felspar. The quartz occurs in large or small rounded or irregular shaped blebs. The felspar crystals are yellowish grey with a greenish tinge, and have indistinct outlines. The veinstuff is composed of quartz chlorite and mica. (?) The quartz is rather glassy and full of minute hollows ¼ inch in diameter, containing well developed quartz crystals and tin-stone. The ore is fairly well mixed through the stone, but occurs principally in small veins of quartz ½ inch thick, traversing the mass of the veinstone. Seventeen tons of stone from this vein, crushed at Tent Hill in 1884, yielded 2¾ cwt. of ore per ton. The strong

strike of this vein, its great horizontal extent, and the richness of the veinstuff invite further prospecting.

59. *The Fergusson Vein*, 2 feet wide, in portion 161, in the same parish, strikes 40° north of east and south of west, dipping north-west, and is probably a continuation of the Wallaroo vein. The foot-wall is well defined. The veinstuff is chlorite and quartz, the former occurring massive, or in veins or concretions in the quartz. The tin-stone is disseminated through the quartz and chlorite, associated with iron pyrites and wolfram. The country is a coarse hard granite merging into the veinstone.

60. About 1½ miles north-east of the Fergusson vein is a vein of amethystine quartz, containing curious skeleton crystals of tin-stone, the tin crystallites being grouped round certain axes, as in the case of snow crystals. This is about 1½ feet wide, and strikes about 43° north of east and south of west.

61. *Reid and Crane's vein* in portion 700, parish of Wellington Vale, county Gough, strikes 37° 30′ east of north and west of south, dipping north-west. The vein has been proved for a distance of over ¼ of a mile, two shafts having been sunk on it to depths of 50 and 55 feet respectively. The vein varies from 8 inches to 3½ feet in width. The walls are not always well defined, as they come together in places so as to form a single central crack, the sides of which are infiltrated with vein material. The veinstuff is ferruginous quartz, chlorite, and fluorspar. The last occurs in seams 1 inch wide, traversing the chlorite. The tin-stone is present in well-formed crystals in the quartz and chlorite, favouring the foot or hanging walls, and occasionally the centre of the vein. The granite enclosing the vein is not very hard, and consists of blebs of quartz, ⅓ inch in diameter, in a more finely crystalline base of large and small crystals of felspar and dark mica. The joints trend 32° west of south and east of north. This vein is probably a continuation of the Fergusson and Wallaroo, the strike having changed with that of the jointing in the granite. Fifty tons of ore from this vein are said to have averaged over 3 cwt. of tin-stone per ton, equal to 13 per cent.

Lee's Gully veins.—Seven distinct veins are included in this set.

In portion 483, parish of Annandale, county Clive, are four veins.

62. The westernmost strikes 34° east of north and west of south, dipping north-westerly. The vein is altogether 4 feet wide, of which from

6 to 8 inches are tin-bearing. The foot-wall is defined, but what is considered to be the hanging-wall seems to be a joint in the granite, showing faint traces of slickensides. The barren veinstone is a hard quartzose felstone, containing a little mica; the tin-bearing portion of the vein is composed of ferruginous quartz and chlorite. The tin occurs disseminated in small black crystals, or massive in nests or strings.

63. Thirty-four yards easterly is a vein similar to the preceding, striking 38° east of north and west of south.

64. Twenty-eight yards further east is a similar vein striking 40° east of north and west of south, dipping 70° north-westerly, and containing, in addition to tin-stone, wolfram and hæmatite. The tin-stone runs in three seams through chlorite.

65. Forty yards further east is another similar vein, striking 43° east of north and west of south, dipping north-westerly. The walls are fairly well defined, and show slickensides. It would appear from the strike of these veins that they should converge near the south-west corner of portion 483.

66. Near the north-west corner of portion 515, in the same parish, are two contiguous veins, not shown on the geological map, striking 20° east of north and west of south, dipping about 86° north-westerly. The principal vein in places is from 4 to 5 feet wide, containing fine black tin-stone. This is perhaps the champion vein.

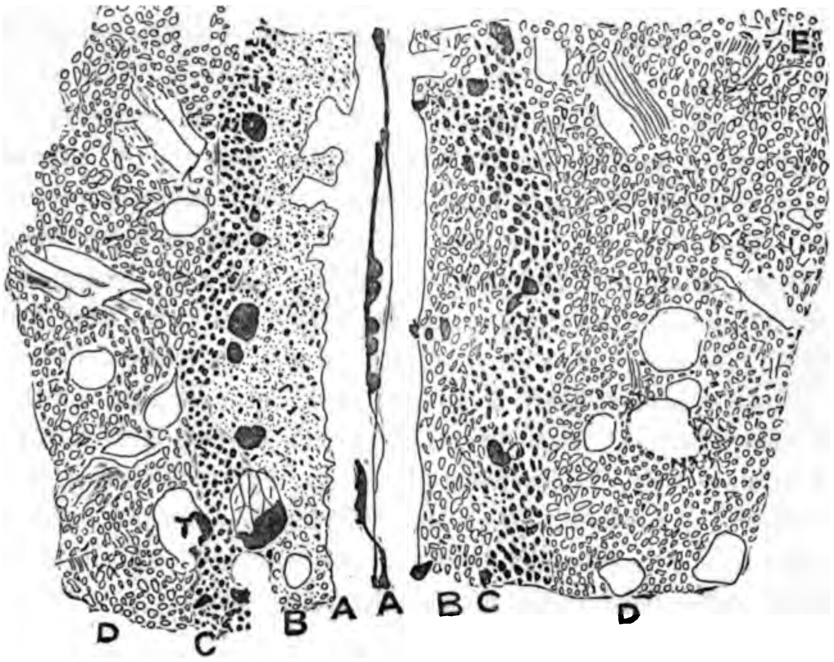
67. Near the south-east corner of portion 259, thin tin-bearing quartz veins strike 38° east of north and west of south, dipping 86° north-westerly. The country, as before, is a hard fine-grained quartzose granite, almost a felstone. One of these veins has been traced for over 14 chains, and is from 3 to 6 inches in width, carrying a seam of solid tin-stone ½ inch to 1 inch wide.

68. In portion 275, in the same parish, the north vein shown on the plan strikes 40° north of east and south of west, composed of quartz and chlorite, and from 5 to 6 feet wide.

69. The vein south of the preceding in the same portion strikes about 26° east of north and west of south. A shaft has been sunk on the vein over 100 feet deep. The veinstone, which is similar to the preceding, is said to be from 3 to 4 feet wide in the shaft. The tin is fine and black, occurring in thin seams intersecting the quartz. The veinstone is decidedly poor in ore. The Cliff vein, probably a continuation of the preceding, strikes through portions 288 and 289, in a direction 26° east of north and west of south,

dipping 85° north-westerly. A good natural section may be seen of this vein, which is a very characteristic example of the surrounding veins. (*See* Fig. 10.)

FIG. 10.



Natural scale.
A.A.—Quartz, lining sides of crack in granite.
B.B.—Felspar with a little quartz and tin.
C.C.—Crystals of tin-stone.
D.D.—Coarsely crystalline granite, with large crystals of felspar and quartz in micro-pegmatitic base of quartz and felspar.
E.—Felspar crystal enclosing small crystal of tin-stone in its centre.

The vein has all the appearance of being a joint in the granite, in which the tin has become concentrated by some process of lateral secretion or infiltration. In portions 273 and 274, in the same parish is a similar vein, striking 35° east of north and west of south, dipping slightly north-west. The vein consists of a central joint, on either side of which the granite is impregnated with quartz and tin-stone for a distance of 6 inches. The thin veins of quartz and tinstone here are far too numerous to admit of their being plotted on the geological map, the greater part of the northern and north-western slopes of the Battery Mount being a vast stockwork.

70, 71, and 72. In portion 173, parish of Wellington Vale, county Gough, are Davy's four veins in granite, within a distance of 5 chains, striking from 28° to 30° east of north and west of south, the width varying from 2 inches to 3 feet, the average width being 9 inches. Tin-stone occurs in quartz and mica. The foot-walls are fairly well defined, but there are no hanging-walls, the lode stuff clinging firmly to the granite casing. The veins are crossed nearly at right angles by dykes of eurite.

The thin veins of tin-stone and quartz in the neighbourhood of Emmaville differ in some respects from any of the preceding. The country rock here, as already described under the head of general geology, consists of quartz-porphyry or eurite, partly metamorphic and partly intrusive. The pebble conglomerates and finely laminated chert-beds among these crystalline rocks, prove that they were in part originally of sedimentary origin, while the manner in which rocks closely resembling them in Lennon's and the Wesley ground have been squeezed into the claystone shows that the rock is also partly intrusive. The rock is much jointed in several directions, the principal joints running from 3° to 20° north of east and south of west, crossed by others bearing from 10° to 30° south of east and north of west. The width of these veins varies from $\frac{1}{12}$ of an inch to 3 inches, the average thickness being $\frac{1}{4}$ of an inch. The most favourable country rock for these veins appears to be a greenish eurite, highly cleaved, soft, and felspathic. If the rock becomes hard and quartzose the veins cease.

73. Thin veins of quartz and tin-stone of this description were cut in some of the deep lead drives in the Wesley ground near the junction of the eurite with the claystone; also in Fox's deep lead workings in portion 47, parish of Hamilton, county Gough, numerous fragments of vein quartz containing tin-stone (locally termed "specimens") were found among the deep lead gravel, a sure indication of the proximity of tin veins.

74. In the south-west end of portion 42, parish of Strathbogie North, are several thin veins of quartz and tinstone in eurite, striking from 10° to 30° south of east and north of west, none of them being more than 1 inch in diameter.

75. In portion 236, in the same parish, are two sets of similar minute veins, having the same strike.

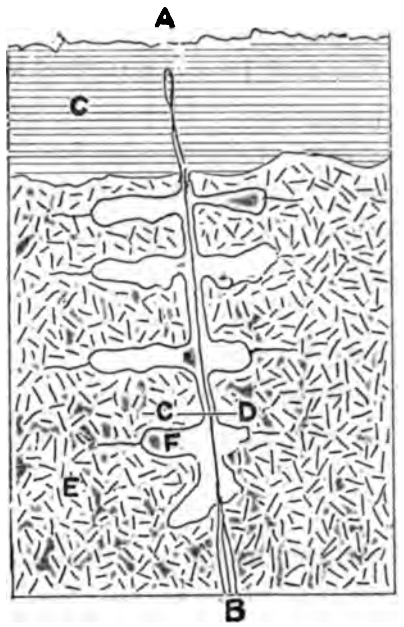
76. In portion 43, in the same parish, are a number of thin veins, varying from $\frac{1}{4}$ to $\frac{1}{2}$ inch in thickness, following the cleavage planes of the quartz-porphyry, and bearing from 15° to 20° north of east and south of west, crossed by others coursing 20° south of east and north of west; in the southern set one of the veins $\frac{1}{2}$ inch wide contains arsenical pyrites.

77. In portion 540, Strathbogie North, at the Great Britain Mine, a number of thin veins of tin-stone and quartz traverse the quartz-porphyry, bearing 3° north of east and south of west, dipping 70° north-westerly, and varying in thickness from $\frac{1}{8}$ inch to $\frac{1}{2}$ inch. The rock here is a perfect stockwork, the veins in a width of 5 feet having an aggregate width of 1 inch, of which $\frac{1}{5}$ may be tin-stone. A bed of finely laminated chert runs parallel to these veins, a few chains to the south. The former dips 6° east of south and west of north at 3°. A shaft has been sunk on one of these veins to a depth of 80 feet, in which distance the vein did not thicken.

78. In portion 253, Strathbogie North, within a space of 10 yards, are as many minute veins of quartz and tin-stone, intersecting a greenish felstone, and having a thickness of from $\frac{1}{12}$ inch to $\frac{1}{3}$ inch, and an aggregate thickness of $1\frac{1}{3}$ inch. (See Fig. 11).

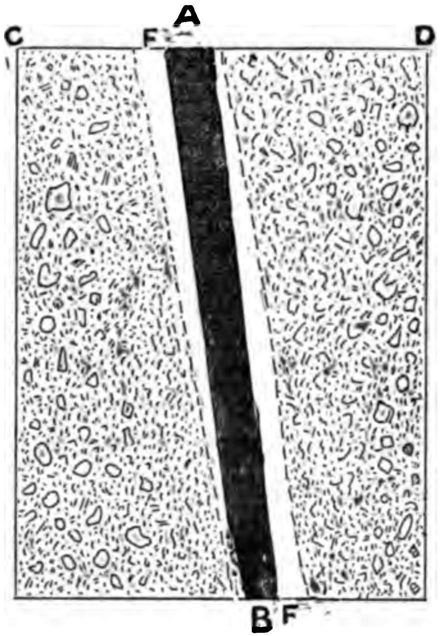
79. In portion 116, Scone, is Bath's lode, the largest of the stockwork veins yet found near Emmavile The vein strikes 5° north of east and south of west, dipping southerly at 85°. The vein consists of a seam of quartz and tin-stone on either side of a central crack, both faces of which show slickensides, and it merges gradually into a quartzose quartz-porphyry, which passes into a similar rock, rather softer and less quartzose. Floors of quartzose quartz-porphyry extend laterally for a few feet on either side of the vein, probably formed by the infiltration of quartz derived from the vein along horizontal joints in the quartz-porphyry. [*See* Fig. 11.] It seems to me improbable that any of these minute veins, if sunk upon, would be found to widen out into payable lodes, except perhaps at great depths; for, considering that they have been worn down already for a vertical extent of at least 200 feet for a length of 3 miles, it might have been expected that had wide bunches or shoots of tin-bearing quartz occurred in them, water-worn blocks of quartz veinstone a foot or so in diameter would certainly have been found in the cainozoic tin-gravels, as at many places on the Mole Tableland and in the Tingha district. Near Emmaville, however, the quartz pebbles in the leads seldom exceed 3 inches in diameter, the associated fragments of quartz-porphyry measuring over 1 foot. There can be no doubt that all these minute veins are connected with the set about to be described, of which the Ottery is the principal one, and the rock in which they occur appears to be intimately related to the great dyke of hornblendic granite in Boiling Down Creek, to which the Ottery lode chiefly owes its origin.

FIG. 11.

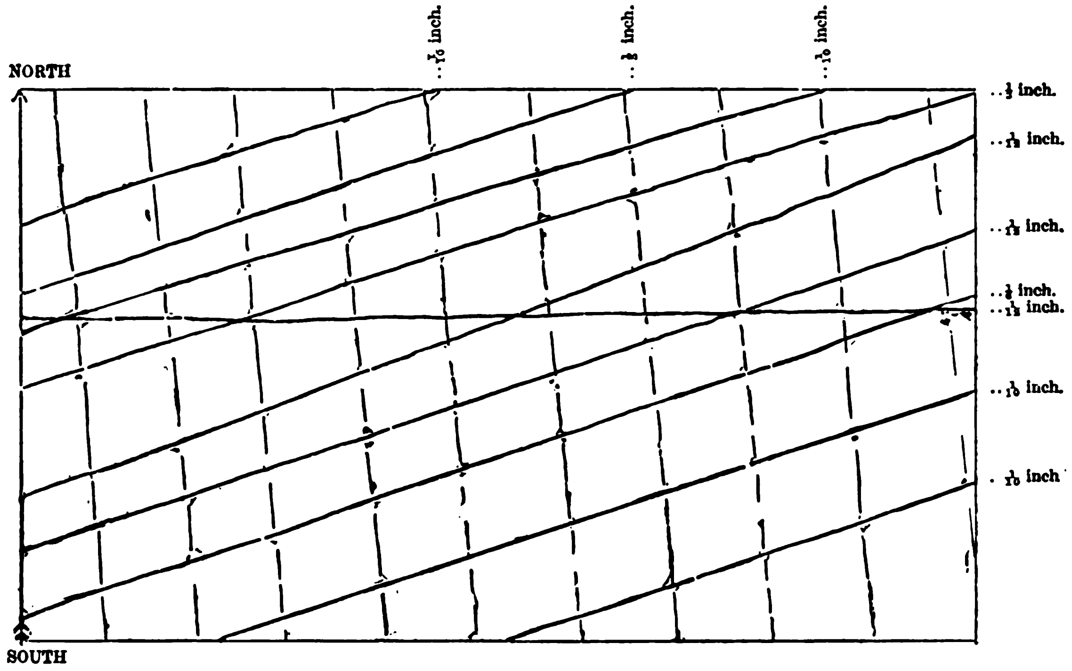


A.B.—Bath's tin vein.
C.D.—Section lines in detail to right.
E.—Eurite.
F.—Quartz which has permeated eurite along horizontal joints.
G.—Soil and sub-soil formed from decomposed eurite.
Vertical extent of section, 12 feet.

DETAIL
Natural Scale.



A B.—Tinstone.
F.F.—Quartz.
C.D.—Eurite.



The continuous lines denote veins of tin-stone.
The broken lines, joints in the eurite.

80. In portion 4, parish of Tent Hill, is a vein of quartz and tin-stone striking 33° north of east and south of west, dipping north-westerly; the vein is a continuation of one of the Ottery lodes. The country rock is a dyke of coarse hornblendic granite, 6 chains wide, and bounded by claystone which shuts off the reef at each end.

81. Near the south-west corner of portion 3, in the same parish, a vein has been prospected striking north-east and south-west, and dipping north-west at 70°. The vein is about 1 foot in width, and contains a little tin-stone in quartz.

82. In portion 2, in the same parish, is McMaster's vein, another branch from the Ottery lodes. The strike varies from 17° east of north and west of south to 23° north of east and south of west, the bearing of the reef conforming roughly to that of the margin of the great dyke. The dip is 58° north-westerly. The veinstone is a gossany green felstone traversed by quartz veins, and containing massive mispickel and tin-stone. The quartz veins are from $\frac{1}{8}$ to $\frac{1}{2}$ inch wide. Porphyrite forms the wall of this dyke mass on the south-east; to the north-west the mass is connected probably with the hornblendic granite.

83. O'Donnell's reef in portion 5 of the same parish, is also a continuation of one of the Ottery veins. The vein strikes 20° east of north and west of south, dipping north-westerly, and is from 1 to $1\frac{1}{2}$ feet wide. The veinstone is a gossany friable quartz containing tin-stone, with black and green stains, due to the decomposition of arsenical pyrites. The vein has been sunk upon to a depth of 15 feet.

The Ottery veins, of which the preceding is a continuation, are a very important set of tin-bearing reefs, nearly all of which are situated in portion 47, in the parish of Tent Hill, county Gough, $1\frac{1}{2}$ miles distant from the Glen Company's Smelting Works. The outcrop is on the side of a hill sloping steeply to the north, the difference in level from the lowest point of outcrop to the highest being 120 feet. The country consists of three dissimilar rocks, claystone, hornblendic granite passing into greenish-grey eurite, and dark-blue porphyrite. It is possible, however, that the porphyrite is a highly altered claystone.

The Ottery veins.—These veins are contained in the dyke masses of hornblendic granite and eurite, and all lie within 8 chains of the junction line of the claystone with the granite, the main dyke being 100 feet wide in places, and connected with the great dyke in Boiling Down Creek. From figure 12 it would appear, that there is one main vein, an east vein, a west vein, and a cross vein north of the main vein. Between the cross vein and the north end of the main vein are two veins which appear to be branches of the main vein, and will be referred to as its east and west branches. All these veins dip westerly at from 30° to 80°.

84. The main vein has been worked at the south end in a northerly direction, at intervals, for about 260 yards, the principal shafts being 122 feet, 75 feet, and 130 feet deep respectively (measured on the underlie). Near the 122-foot shaft, at the top of the hill, a lump of tin-stone was found weighing 2 cwt. 1 qr. and 24 lb., assaying 72 per cent. of metallic tin. The general strike of this vein here varies from 15° to 28° east of north and west of south; in places the vein is vertical, but for the most part dips westerly at from 63° to 73°. The thickness of the veinstuff here is about 3 feet. The veinstone is principally drusy quartz, containing hydrated oxides of iron, mispickel, and tin-stone. From the surface to a depth of 45 feet the vein consisted of ferruginous gossany quartz, the iron oxides wrapping round and obscuring the tin-stone. Below this the oxides of iron and arsenic passed into compact sulphides. A shoot of ore was worked here at 50 feet from the surface, 90 yards long, 5 yards high, and from 4 inches to 1 foot wide. The shoot dipped aslant the plane of the vein at an angle of about 20° from the horizontal; at its lower end the shoot became nipped, a thin vein of quartz only 1 to 2 inches wide marking the continuation of the vein. The ore in this shoot consisted of nearly solid tin-stone. The main vein at the 130-foot shaft dips at 42° to the 60 feet level, the slope lessening to an angle of 38° at 75 feet, and 31° at 115 feet from the surface. The average width of the vein was about 3½ feet, the thickness varying from 6 inches to 6 feet. The foot and hanging walls were both well marked and clean, showing slickensides, and lined in places with a selvage of tenacious brown clay ½ inch to 1 inch in thickness, which is also found filling transverse cracks and cavities in the lodestuff. The iron oxides in this shaft extended to a depth of 75 feet, when they were replaced by sulphides. At 60 feet from the surface a level was

driven on the vein to the south-west for 110 feet, at which distance the vein became pinched. To the north-east the vein was stoped out to a distance of 40 feet from the shaft, at which point the vein was found to be split by a "horse" of granite, causing it to be somewhat impoverished. In this total lateral extent of 50 yards the vein was tin-bearing for 45 yards, and averaged 3½ feet for 32 yards. The veinstuff was richest next the foot and hanging walls, the centre of the vein being rather poor in tin-stone. The veinstuff contained a fair percentage of tin-stone as long as the angle of dip was not less than 40°; but when the dip lessened at 115 feet to 31° the vein became contracted and impoverished; and at 124 feet it was completely cut off by a horizontal floor. Followed in the direction of the dip the vein was found again, and widened gradually to 6 inches at 130 feet. The veinstone at the bottom of the shaft consisted of massive arsenical pyrites and drusy quartz, with quartz freely crystallized in vughs partly filled with arsenical and iron pyrites. I have been informed by the manager for the Glen Smelting Company (Mr. J. Reid), that this shaft has now been sunk to a depth of 180 feet (on the underlie), and that good ore was got at 150 feet and continued to that depth; the best bunches were won from between 150 and 170 feet from the surface, 30 tons of ore from which yielded 20 per cent. of tin-stone. It is a significant fact that the point where this rich shoot of ore was got is just on the line of dip of the shoot lost in the upper 122-foot shaft. [*See* Fig. 12 B.*]

*See accompanying plan.

About 3 chains northerly from the 130-foot shaft a continuation of the vein has been worked in an open quarry. The vein here is from 3 to 5 feet wide; the strike is 32° east of north and west of south, but varies owing to the vein taking a number of turns or rolls; and the dip is about 54° south-westerly. The foot-wall is well marked, but the hanging-wall less so; and next to the hanging-wall the veinstuff is felstone passing into quartz, green with arseniate of iron. Tin-stone is well disseminated through the mass of the veinstuff, and occurs in small crystals next the foot-wall, in drusy quartz. The west branch of the main vein has been prospected by a similar open excavation. Its strike is 3° east of north, and its dip 54° westerly; the veinstuff is from 3 to 4 feet in width; the foot-wall is uneven, but strongly slickensided; and the hanging-wall is fairly well defined. The veinstuff is a friable, arsenical, ferruginous quartz and felstone; and the tin-stone is finely crystalline disseminated through the quartz, chiefly on the foot-wall.

Two chains north-east from the preceding is the east branch of the main vein. The strike of this branch varies from 10° west of north to 20° east of north; its dip is westerly at from 50° to 70°; its average width 3½ feet; its foot-wall well defined and strongly slickensided; and its hanging-wall not well defined. The veinstuff is chiefly felstone, with arsenical ferruginous quartz. Probably both these branches belong to the main vein, and will unite at a depth.

Two chains northerly from the west branch, on the line of its strike, a shaft has been sunk on a vein of nearly massive arsenical pyrites, iron pyrites, and blende, with a little tin-stone. Sinking was discontinued here owing to the vein becoming poor in tin-stone, mispickel being very abundant.

85. *The Cross vein* has been proved 2 chains north from the preceding, at intervals, for a distance of 11 chains. Its strike is 40° north of east and south of west. At the 15-foot shaft, and at the north-east excavation, the vein is nearly vertical, with a slight underlie to the north-west. The width is at least 5 feet; the hanging-wall well defined, but the foot-wall not yet found; and the veinstuff consists of quartz with mispickel and tin-stone. The tin-stone runs in floors across the vein, dipping north-west into the hanging-wall, the floors being from 3 to 4 feet apart. A continuation of this vein has been found 5 chains south-westerly from the 15-foot shaft, where a tunnel has been driven on it into the hillside. The strike of this continuation is 32° north of east; its dip 77° north-westerly; the width of the vein is 3 feet, with the hanging-wall showing slickensides; and the tin-stone is found chiefly in a vein of quartz 6 inches wide.

86. *The East vein* has been sunk on to a depth of 56 feet, about 2 chains east of the main vein. Its strike is 20° east of north and west of south; it has a good foot-wall showing lateral slickensides; its dip is 74° westerly, and its average width 1½ feet. The vein is cut across horizontally by floors of clay; the tin-stone occurs in a drusy ferruginous quartz, with a little chlorite; and the vein was tin-bearing from the surface down to the bottom of the shaft.

87. *The West vein*, 4 chains north-west of the main vein, strikes 28° east of north and west of south; its underlie for 20 feet from the surface is 78° north-westerly, thence to near the bottom of the shaft 78° south-easterly, and at the bottom of the shaft 72° south-easterly. The average width of the

vein is 5 inches; the veinstuff consists of friable ferruginous quartz rich in tin-stone, and free from iron pyrites and arsenic. The country is fairly soft. The south-easterly underlie of this vein argues that it is a feeder to the main vein, and should unite with it at a depth.

SUMMARY.

The Ottery veins occur in dyke masses of hornblendic granite and eurite, within 8 chains from the margin of the claystone. The main vein with the cross vein has been proved to be productive of tin for a distance of over ¼ mile, and for a vertical extent of over 160 feet. The well-defined nature of the walls, the strong slickensides, and the quantity of clay flucan lining the veins, proclaim this to be a true fissure vein. It will be noticed that in all cases where the inclination of the vein from the vertical became suddenly lessened, it became pinched and unproductive, confirming the well-known experience of miners that those parts of a vein which most nearly approach the vertical are generally the richest. The strike of the veins follows approximately that of the junction line between the porphyrite and claystone. [*See* Geological Map.] The dip, except in the case of the west vein, is north-westerly, following the underground line of junction between the crystalline rocks and the claystone, giving these ore bodies the character of contact deposits. The ore in these veins occasionally runs in shoots, which dip to the north-east, following, perhaps, the dip of the sedimentary rocks in the immediate neighbourhood. The shooty character of the ore is, however, less observable here than elsewhere. At the time of my visit 1,200 tons of veinstone from these veins, crushed at Tent Hill, yielded a trifle under 5 per cent. of tin-stone, and subsequent crushings have yielded a little over 3 per cent. As soon as the shafts and levels have been extended sufficiently to admit of stoping on a large scale these mines should pay.

88. *The Folkestone vein* is situated in portion 82, parish of Wellington Vale, county Gough. The vein is enclosed in a metamorphic diorite, near the margin of the intrusive granite boss of the Mole Tableland. The vein courses east and west, is from 8 to 18 inches in thickness, and consists of quartz containing iron pyrites, mispickel, blende, galena, and a little tin-stone. A shaft has been sunk on the vein to a depth of over 100 feet, but sinking was discontinued, as the vein did not become richer in tin-stone. The probability is that if the sinking were continued through the metamorphic diorite on to the granite, the iron and zinc sulphurets would be gradually replaced by tin-stone.

89. *The Planet Mine,* situated in portion 119, in the same parish, strikes 11° north of west and south of east, and is apparently vertical, in country rock of fine-grained dark greenish-brown metamorphic diorite. The vein is about 3 feet wide, and consists of quartzose veinstone, with great quantities of arsenical pyrites and a little wolfram.

90. In portion 122, Wellington Vale, is a similar vein in similar country, striking east 10° north, and having a width of from 7 to 8 feet. This vein has not yet been prospected. The metamorphic rocks enclosing these veins are rich in iron sulphides, iron pyrites being disseminated through the diorites in cubes from $\frac{1}{8}$ to $\frac{1}{3}$ inch in diameter. Both of these veins are worthy of attention.

SUMMARY OF TIN VEINS.

The following provisional classification, based on the foregoing observations, is proposed for the tin veins of the Vegetable Creek District:—

I. *True veins,* comprising—1. Fissure veins; example, "Ottery veins." 2. Joint veins; example, "Cliff vein." Both these subdivisions may be further differentiated according as the veins to which they apply are *right running* or *marginal,* the right running veins being those which conform to the principal system of cracks in the granite, while the strike of the marginal veins accord closely with that of the junction line of the claystone and granite.

II. *Pipe veins,* "impregnations" or "carbonas;" example, "Graney's vein."

III. *Stockworks.*—1. Formed by lateral secretion (?) from the surrounding rock; example, Stockwork at "Gap," Emmaville. 2. Formed by ascension and infiltration; example, Stockwork at "Hall's Grampians."

These three classes cannot in practice be always separated from one another by a hard and fast line.

Joint veins, with shoots of ore at intervals, graduate into pipe veins; a fissure vein, by a change of strike, becomes a joint vein, and both, if they pass into a hard quartzose granite, are liable to become split up into a stockwork composed of numerous thread-like veins.

The following appear to have most influence on the metalliferous character of these veins :—

1. Country rock.
2. Bearing of the vein, and relation of its bearing to that of joints in the country rock.
3. Amount of dip.
4. Associated minerals.
5. Development of walls.

1. Country Rock.

76 veins are enclosed in granite.
8 ,, ,, quartz-porphyry and eurite.
3 ,, ,, porphyroid.
3 ,, ,, claystone.

A fine-grained hard quartzose granite is unfavourable, causing the veins to be narrow, and in some cases to become split up into a number of thin seams, as in the "Gulf" group of veins, and the stockwork at Battery Mountain.

Fine-grained schorlaceous granite seems equally unfavourable, as evidenced by Macdonald's lodes on the Glen Creek, where veins of tin-stone and tourmaline, from 1 inch to 2 inches wide show no appreciable alteration in thickness in a vertical extent of 200 feet.

Porphyritic granite, with large, well-formed white crystals of felspar is also prejudicial, as in the neighbourhood of the Haystack Mountain, where the quartz veins, as a rule, are not tin-bearing.

The most favourable granite appears to be that in the neighbourhood of the "Dutchman" mines. The rock in that locality is moderately hard, and may be described as an open-grained ternary granite, containing rather large greenish crystals of felspar, not sharply defined at the edges, but merging gradually into a more finely crystalline mass of felspar, quartz, and mica. Patches and bands of more coarsely crystalline rock are intermixed with the more finely crystalline, and geodes of felspar are not uncommon.

Eurite dykes intersecting the coarse granite are also favourable.

If the country rock be quartz-porphyry or eurite, the fairly soft strongly cleaved felspathic varieties with a greenish tinge due to the presence of chlorite or hornblende, are more favourable than those which are hard, less cleaved, quartzose, and white.

2. Bearing.

The average strike of fifty-four "right running" tin veins in the Mole Tableland granite is 39° 15′ east of north and west of south, the range of strike being from 24° east of north and west of south to 20° north of east and south of west. The average strike of the richest veins is 35° east of north and west of south.

8 veins strike exactly 40° east of north and west of south.
7 „ „ „ 35° „ „

Out of thirty veins observed, seven exactly conform to the principal lines of jointing in the surrounding granite, while twenty-three do not, but intersect the joints at an acute angle of about 5°.

3. Amount of Dip.

The average dip of thirty-seven veins observed is 77°.

33 veins dip north-westerly.
10 „ „ south-easterly.
3 „ are vertical.

Those veins or parts of veins most nearly approaching the vertical have so far proved the richest, as at the Ottery Mine, Butler's Reef, &c.

4. Associated Minerals.

Out of seventy-seven veins in which tin-stone has been proved to occur, nineteen consisted of quartz and tin-stone only, eight of tin-stone and felspar only.

The relative frequency of occurrence and character of minerals, associated in the veins with tin-stone, is given on the following table:—

69 veins contain quartz
29 „ „ chlorite
20 „ „ felspar
8 „ „ mica
8 „ „ mispickel
4 „ „ iron pyrites

4	veins	contain	fluor-spar
3	,,	,,	tourmaline and schorl
3	,,	,,	wolfram
2	,,	,,	blende
2	,,	,,	galena
2	,,	,,	copper pyrites
2	,,	,,	bismuth
2	,,	,,	molybdenite
2	,,	,,	vesuvianite
2	,,	,,	stilbite
1	,,	,,	hæmatite
1	,,	,,	phyrrhotine
1	,,	,,	manganese
1	,,	,,	scheelite
1	,,	,,	beryl

5. Development of Walls.

Well defined walls were observed in 14 cases, generally showing slickensides. The foot-wall is usually cleaner and better defined than the hanging-wall. The best veins in the district have good walls. Where walls are absent their place is taken by a central crack traversing the veins, the veinstuff on either side passing very gradually into granite.

Commercial Value of Tin Veins.—Apart from considerations of cost of labour and carriage, two conditions which most directly affect the value of a vein are:—

1. Size of vein.
2. Proportion of ore contained in the vein to the veinstone.

1. *Size*—(*a*) *Length.*—The greatest length for which a vein has been observed by me to be tin-bearing is 1 mile. This is Butler's vein. The Wallaroo vein will also, probably, be found to be tin-bearing for an equal length.

(*b*) *Width.*—The average width of 69 veins is 1 foot 6¾ inches. The following are the thicknesses of six of the largest veins now being worked:—

1.	Ottery vein	3 feet
2.	,, ,, ...	4 ,,
	Butler's ,, ...	3 ,, 2 inches
1.	Dutchman vein	4 ,,
2.	,, ,, ...	3 ,,
	Curnow's ,, ...	3 ,,

(*c*) *Depth.*—The greatest depth to which a vein has been proved to be tin-bearing by shafts is 200 feet, at Curnow's vein. At the Ottery Mine good ore is now being got at 180 feet from the surface (measured on the underlie), and at the Gulf Mine a payable shoot of ore was worked at 175 feet. Far wider evidence, however, than that afforded by shafts, is to be gathered from a comparison of the levels at which the veins are found to be tin-bearing at different points in close proximity, and from a rough estimate, based on natural sections, of the vertical distance between the point where a vein commences to be tin-bearing and the point where it ceases to be so. The present surface of the granite, in which the tin veins occur, was not surface ground at the time of their formation. This statement may seem absurdly obvious, but in practice many mistakes arise from an imperfect comprehension of this simple fact. Many miners appeared to me to be under the impression that the veins had been formed in fissures in the ***present*** surface of the granite. In consequence, after sinking to a depth of about 100 feet, which is as far as most individual shoots extend vertically, and finding that the ore became nipped, they have abandoned the work in the belief that the ore could not have penetrated from the surface below this level. Hence the number of old shafts in the district in which sinking has been discontinued at depths generally not exceeding 100 feet. Where a good shoot of ore has been showing on the surface, work has been commenced, and the shoot worked out; but seldom have attempts been made to win underlying shoots by continuing the sinking below the impoverished portions of the veins. The existence of such underlying shoots has been proved at the "Gulf" and "Ottery" mines. That the present surface of the Mole Tableland granite is mostly far lower than it was at the time when the tin veins were formed is proved, (1) by the coarsely crystalline structure of the granite, the formation of such a structure being possible only under great vertical pressure such as would be produced by the superincumbent weight of several thousand feet of strata; (2) By the great quantity of stream tin at the bottoms of the deeply eroded valleys of the Mole Tableland, attesting a vast amount of vein material removed by denudation. Where a valley intersects a tin vein, and the vein is found to be tin-bearing at the bottom of the valley as well as at a point on one of its sides, say 200 feet above, the assumption is justifiable that the vein if sunk upon at the high level will prove to be tin-bearing downwards at least as far as will bring it on a level with its lower tin-bearing outcrop at the bottom of the valley, *i.e.* for 200 feet. Nature, by carving out that valley has notched the reef to that depth, and so has practically prospected it. According to this method of calculation the principal veins of the Mole Tableland, unless thay have been greatly denuded, should continue to be tin-bearing for a vertical extent of at least 400 feet. The absolute distance to which individual veins will prove to be tin-bearing, cannot, of course, be ascertained without actual experiment. The following facts, however, prove that there are certain upward and downward limits to the tin veins which can be roughly stated. On consulting the geological map accompanying this report, it will be noticed that the commencement of most of the veins is situated near the junction of the claystone with the intrusive granite, so the upward limit of the veins may be said to be the bottom of the claystone and top of the granite. The map also shows that as a rule the granite at a distance of over 1¼ mile from its junction line with the claystone ceases to be tin-bearing. The barrenness of the portions of the granite boss at a greater distance than this from the claystone, appears to me to be due to the fact that these central portions have at one time been higher than the surrounding granite, and consequently have suffered more from the effects of denudation, so that the tin veins which once over-arched these barrren patches have been entirely swept away. The question now arises, to what extent has the granite been worn down at the points where it ceases to be tin-bearing. To ascertain this, it would be necessary to restore approximately the original surface of the granite, and, consequently, the surface of the veins over these points. Such a restored outline would, probably, take the form of a curve or succession of curves, and to calculate their amount roughly, it would be necessary to discover the angle at which the granite emerges from the claystone. In Cornwall, England, deep mines in the killas near its junction with the granite, sunk through the former into the latter rock, show that the intrusive granites there dip under the killas at about 45°. A few observations, however, in the Vegetable Creek District, led me to infer that the angle of dip and consequently of emergence of the granite here does not exceed between 10° and 20°. At this rate the veins would die out between 1,000 and 2,000 feet. Great latitude, however, must be allowed in making such a calculation for the nature and size of the vein, as wide fissure veins would obviously extend far deeper than narrow joint veins. The above statement applies only to those veins which dip away from the claystone into the granite, as is generally the case. A few veins, notably the "Ottery," dip towards the claystone. For the downward limit of such deposits I was unable to obtain any evidence, but they appeared to me to show more signs of permanence than veins of the former class. The underlie of the veins agrees with the dip of the sedimentary palæozoic rocks, but I was unable to discover why the shoots usually pitch to the north-east.

2. *Proportion of ore contained in the vein to the veinstone.*—Owing to the distribution of the ore in shoots, the yield of the veinstuff varies considerably in different parts of the same vein, ranging from ½ to 70 per cent. The average proportion of ore contained in the veinstones of three of the largest veins, after the stone has been roughly sampled, is 3½ per cent. The average width of worked tin veins in granite, in Cornwall, England, is 3 feet. In the Vegetable Creek District there are only six tin veins which maintain or exceed this thickness for a considerable distance. These are:—Ottery veins (2), Dutchman veins (2), Butler's vein, Curnow's vein. The Wallaroo vein, of which Reid and Crane's vein on tributary of Bark Hut Creek is a continuation, also maintains a thickness of from 2 to 3 feet for some distance. None of these veins at the time of my visit quite paid the expenses of opening them out. Little stoping, however, had been done, the principal work being the sinking of shafts and driving of tunnels. There are good reasons, therefore, for expecting that when opened out, and stoped on a larger scale, several, if not all of the veins above mentioned, will be worked profitably. Some of the smaller veins containing rich shoots, as the "Gulf" and the "Torrington," may also be worked to advantage on a small scale; the small quantity of veinstuff available for treatment precluding their being worked on a large scale. Of the remaining veins, the majority of which are too thin to be worked profitably, those most worthy of further prospecting have been specially mentioned as such in the above detailed account of the tin veins. The total quantity of tin ore raised from veins in the district up to the end of 1886 was about 1,570 tons.

CLEANING AND DRESSING TIN ORE.

The stream tin is separated from the gravels of the shallow and deep leads, on the specific gravity principle, by means of running water.

Where the tin gravel has been cemented by oxide of iron or by silica, or much hardened by the heat and pressure of the overlying basalt, it has to be puddled and even stamped—as at Hall Brothers' mine at Kangaroo Flat—before it can be sufficiently finely divided to admit of its being effectively treated in the hopper and sluice box.

The various modifications of the tin-saving appliances in use in the district have already been so elaborately described in the reports by the Mining Registrars, published in the annual reports of the Department, that any further account of them here would be superfluous.

The vein tin is separated from the gangue by means of stamping with a battery, the ore being abstracted from the stone after it has been thus powdered, by means of jiggers, concentrators, buddles, &c.

The principal crushing and tin-saving machinery is that attached to the Glen Smelting Company's Works at Tent Hill, and comprises:—10 head of stamps, each weighing about 6 cwt.; 2 classifiers; 1 pair of double jiggers worked by plungers; 1 Humboldt jigger; 2 Rittinger shaking tables; 2 rotating tables; 1 frame; 12 settling pits; 1 stream box, and the ordinary sieve or tub, for tossing; 1 brick-making machine, with rollers and pug mill; 1 charcoal crusher; 1 double-cylinder portable engine of 16 horse-power; 1 centrifugal pump.

A detailed description of this machinery is given by Mr. H. A. Gordon, in his "Report on Mining Machinery, &c., in Victoria and New South Wales. Wellington, New Zealand, 1885."

At the Dutchman Tin-mines, the plant consists of:—1 battery, with 5 head of stamps, and fittings for 15 head; 5 sets of jiggers; 2 dressing convex buddles; 1 Blake's steam pump; 1 portable engine, of 12 horse-power.

The Torrington Mine possesses a battery of 5 head of stamps and a portable engine of 12 horse-power. Silent Grove, a battery of 10 head of stamps. A battery comprising several head of stamps is also lying idle at Battery Mountain.

The tin ore, when cleaned and dressed, is sewn up in strong canvas bags and conveyed in drays to the smelting works at Tent Hill. The greater part, however, of the tin-bearing veinstone is sent to Tent Hill to be stamped and dressed. The charge made by the Glen Smelting Company for carrying the veinstone, is as follows:—

From the Torrington Mine to Tent Hill, £1 per ton.
" " Gulf " " £3 "

SMELTING.

About four-fifths of the ore raised in the district is smelted at the Glen Smelting Company's Works at Tent Hill, 3 miles easterly from Emmaville.

These works, which were established in 1874, by Messrs. Moffatt and Harridge, now cover an area of (with dwellings) about 10 acres, and consist of four groups of buildings, viz.:—(1) The Company's assaying department, general store and offices; (2 and 3), two large sheds roofed with iron, covering the smelting furnaces and refining plant; (4), sheds covering the machinery for stamping and dressing the tin ore.

The principal work done by the Glen Smelting Company at Tent Hill, may be described under three heads:—

(1) Assaying alluvial and lode ores.
(2) Stamping and dressing the tin-bearing veinstone.
(3) Smelting and refining the alluvial and lode ores.

Previous to the purchase of alluvial or lode ores by the company, samples of each parcel of ore are taken to the assay department to determine the percentage of metal contained in the ore.

The assay department consists of two rooms, one being used for fire assays, and the other as a chemical laboratory. The former is provided with two furnaces, one of which is used for general reduction work, and the other, being fitted with a muffle, is used for cupelling. The method of assaying tin ores is as follows:—The sample is first ground in an agate mortar to the consistency of flour, from which a quantity equal to 200 grains is taken; to this is added an equal weight of potassium cyanide, and from 30 to 40 grains of charcoal, the whole well mixed and placed in a clay crucible of 6 oz. capacity, which in turn is imbedded in the well-heated coke or charcoal of the reduction furnace. In from 20 to 25 minutes the charge should have become reduced and quite liquid, but, failing this, a little cyanide is usually added, and, when all is fluid, the contents of the crucible are emptied into a small cup-shaped iron mould, and allowed to cool. When cold, the glassy slag is broken with a small hammer, and the button of metallic tin which is found at the bottom of the mould is carefully cleaned and weighed, a comparison of its weight with that of the ore before fusion, giving the percentage of metal present in the ore assayed.

Mr. Reid, the managing partner, also makes assays of lead, silver, and copper ores, &c., for the company, and also in many cases on behalf of the public, free of charge, provided the sample has been taken from some ore deposit in the immediate neighbourhood.

The assays having been completed, the ore is taken to be smelted. The reduction of the ore is effected in three reverberatory furnaces. These are constructed on the usual plan of an ore chamber, separated from the fire-place by a fire-bridge, 1 foot high. The ore chambers, which are oval in shape, are from 14 to 16 feet long, and 6 to 8 feet in width. Their floors sink slightly towards the centre, and the arch, which is 2 feet high near the fire-bridge, slopes downwards towards the far end of the chamber—the object of this being to keep the flames from the furnace as close down upon the ore as possible. A flue at the far end of the chamber communicates with one of two brick chimneys, which are respectively 50 and 60 feet high. The outer walls of the furnaces are built of common brick, the sides, crown, bottom, flues, and all exposed parts being fire-brick. Owing to the great wear and tear of the bottoms and sides, the former are so placed upon iron supports as to be easily removed. The charge for each furnace is 4 tons, 3 tons of ore being mixed with 1 ton of ground charcoal. The charge having being previously moistened with water, is shovelled into the ore chamber, in which heat is maintained by burning wood in the fire-place. The ore is then spread over the bottom of the furnace with a large iron rake or rabble, until it acquires a thickness of about 12 inches at the centre. The heat of the furnace is then gradually raised, the flames from the fire-place playing upon the surface of the ore, and passing through the flue at the far end up the chimney. The charge is stirred from time to time with a rake, especially during the last part of the smelting, and in 12 hours is thoroughly reduced. At the expiration of that time the furnace is tapped, the contents running into a cauldron or float of fire-brick, which is large enough to hold all the metal, and a small quantity of slag. The furnace, having drained, is ready for another charge, and by the time that has been attended to, the temperature of the molten metal has decreased to a point that will admit of removing the slight covering of the slag, without the risk of extensive oxidation. From this it is conveyed in iron ladles direct to the refining pots. These are cauldrons of cast-iron, three in number, capable of holding 5 tons of molten tin. The highly heated metal (previously placed in the 2½ ton cauldron) is allowed to settle for some two hours, after which the upper portion of the metal is ladled into two smaller cauldrons, where, the temperature being lowered, boiling by the immersion of green billets of stringy-bark is resorted to. The green billets are kept immersed by an iron lever, and the steam escapes and causes a violent ebullition of the metal, thus oxidising any impurities, as also a large percentage of tin, which is afterwards recovered by furnace treatment. The metal, after having been boiled for four hours is, when cold, generally soft enough to stand the bending test—this being always taken as the standard of quality. It is then ladled into cast-iron moulds, giving it the ingot shape. Each ingot so cast weighs 50 lb., and assays 99·5 to 99·8 per cent. of metallic tin. The ingots, having been carefully weighed, are packed, placed on drays and forwarded to Glen Innes. The load taken by each dray varies of course according to the state of the roads, the average load being 5 tons, drawn by eight horses.

Since the year 1875 these works have been under the management of Mr. J. Reid, to whom I am indebted for much of the above information.

ROUTES OF ACCESS.

Ingot tin and tin ore produced in the district are despatched to the coast by three routes:—

1. Via Glen Innes and Newcastle to Sydney. Communication by road, 25 miles; by railway, 324 miles; by sea, 90 miles. Total distance, 439 miles. Cost of carriage, £3 16s. per ton.

2. Via Stanthorpe to Brisbane. Communication by road, 85 miles; by railway, 224 miles. Total distance, 309 miles. Cost of carriage, £4 17s. 6d. per ton. The opening of the Great Northern Railway from Deepwater to Stanthorpe will reduce the distance of carriage by road to about 11 miles.

3. To Grafton by road. Distance, 120 miles. Cost of carriage per ton, formerly, £5.

At present the first route is the one preferred.

According to the estimates made by Mr. J. Reid, the manager for the Glen Smelting Company, a saving might be effected in cost of carriage from Tent Hill to Deepwater, of about 12s. 6d. per ton, if a branch line were constructed to Emmaville from Deepwater, via Tent Hill.

Table showing quantity and value of tin produced in the Vegetable Creek District; compiled from statistics given in the Annual Reports published by the Department:—

Year.	Value of ingot tin per ton.	Value of ore per ton.	Total quantity of ore raised in Vegetable Creek District.	Value.
	£	£	Tons.	£
1872	138	48¾	2,592	143,856
1873	118	62		
1874	89	53¾	2,249	125,381
1875	78½	42	3,042	127,764
1876	69½	40	3,009	120,360
1877	66	37	1,749	64,713
1878	59½	30	1,936	58,080
1879	67	36	2,715	97,740
1880	80½	45	3,696	166,320
1881	90½	52¾	4,040	248,401
1882	99	54	3,386	182,844
1883	92½	48¾	2,509	132,313
1884	......	42½	2,241	95,466
Total	......	......	33,164	£1,563,238

SILVER.

Silver has been found in this district in combination with galena, grey copper, and mispickel; the principal localities of its occurrence being the Little Plant Creek, Pye's Creek, and Campbell's lode, 9 miles south-westerly from Emmaville.

The principal silver vein is distant about 7 miles north-west from Emmaville. A good road already exists from the township to within 3 miles of the vein, and I am informed that a dray road could be constructed at a moderate cost for the remainder of the distance. The creek on which the vein is situated has a good rainfall and watershed, and there should be little difficulty in storing sufficient water for mining purposes. The vein was discovered by a local miner, Mr. L. Webb, who obtained globules of metallic silver from the veinstuff by heating it in a forge.

The rocks in which the vein occurs are bluish-grey altered mud stones and clay stones, passing at points of extreme alteration into white felstone and argillite. These altered palæozoic rocks are cut by numerous cleavage planes running principally 10° to 40° north of east and south of west, while their lines of bedding strike about 20° west of north and east of south dipping westerly.

At 3 miles to the north of the point where the vein attains its greatest size these altered rocks are shut off abruptly by intrusive tin-bearing granite. At the same distance to the south, at Hall's Grampians, they pass into the grey argillite, traversed by numerous veins of tin-stone, and copper, as yet little prospected.

Rising in places 5 or 6 feet above the level of the surrounding country the silver vein forms a conspicuous wall-like mass as it strikes through these altered rocks. It may here be described as a breccia vein, composed principally of slate rock cemented and hardened by strings and bunches of quartz. The latter seem to have risen up, or segregated, partly along the cleavage planes of the argillite, and partly parallel to the strike of the vein.

Towards the centre of the vein the cleavage planes of the slate rock may be observed to be much twisted, and occasionally the rock presents the appearance of having been shattered and recemented. There is no sign of walls or of slickensides.

This mass of quartz-veined slate rock forms the capping of the vein, and can be traced for at least a mile and a half along the surface. Within this distance the reef throws off several branches, some of which die out, while others rejoin the main vein. Its average strike is 3° east of north and west of south, and its dip about 73° westerly. The width of the main vein and its branches varies from 1 to 6 yards, but the metalliferous portion, as far as can be seen on the surface, is nowhere more than 3 feet wide, and is confined chiefly to the centre of the vein.

The stone capping the vein shows reddish-brown and pink stains, with streaks of lemon yellow and yellowish-green. The former are due probably to the oxidation of the silver and iron ores; the latter to the presence of carbonate of lead mixed possibly with chloride and bromide of silver.

The chief ores found in this vein up to the present are:—Galena, copper pyrites, mispickel, and a variety of grey copper containing silver and a trace of gold (silver fahlerz). The mispickel, which does not appear to be silver-bearing, occurs principally freely crystallised through the clay slate rock between the veins of galena and fahlerz. The latter are associated with quartz and fluor-spar. Much of the galena is fine-grained, and has returned silver at the rate of 148 oz. to the ton. As far as can be judged from the points where the reef is partially exposed from under the rubble of the hill slopes, the galena occurs in patches, with intervening spaces of barren clay-slate rock. It is impossible, however, to form a correct estimate of its extent until some work is done on the vein. The same may be said of the silver fahlerz. This mineral was observed by me at four different places along the vein, the last point being nearly a mile distant from the first.

At one of these points fragments of this mineral were obtained nearly pure, measuring 9 inches by 3 inches by 3 inches. The samples of stone were selected by me from five different points along the vein, each of the samples containing three or four specimens taken across the vein, 3 feet in width where it was metalliferous. The object of the experiment was to ascertain the probable yield of silver if the vein were quarried out bodily for 3 feet in width and all the stone were treated. These samples, when assayed by Mr. J. Reid, produced silver at the average rate of 7·3 oz. per ton. It must be stated that a great deal of barren stone, which would of course have been rejected if the ore had been picked, was purposely mixed up with the silver ore; so that the above return should be considerably below what the bulk of the veinstuff ought to yield when selected and dressed.

The future prospects of the vein will evidently depend chiefly on the extent of silver fahlerz, and on whether or not it continues to be rich in silver when traced away from the spot from which the original samples were taken. That the vein is metalliferous for some extent vertically is proved by the natural sections afforded by the gullies which cross its line of strike and have worn it down in places for over 100 feet, showing it to be silver-bearing throughout from the higher to the lower levels.

Since the time of my visit the vein has been sunk upon at thirteen different points, and grey copper rich in silver has been proved to extend downwards for at least 210 feet from the surface. The vein is being systematically prospected by Webb's Silver-mining Company (Limited).

Four picked samples of ore selected by me from this vein, and assayed by the Government Analyst, gave the following results :—

1. Fine silver at the rate of 124 oz. 19 dwt. per ton.
   Gold at the rate of 2 dwt. per ton.

Silver also occurs in Campbell's lode on the south side of the Severn River, 9 miles south-westerly from Emmaville, where it is associated principally with galena and carbonate of lead.

The veins of mispickel shown on the Geological Map as crossing the Two-mile Creek, between Mr. H. Gordon's two-mile and three-mile sheep-stations, also contain a small percentage of silver, though not rich enough to be payable.

Lead occurs as carbonate at Pye's Creek, near Bolivia, Little Plant Creek, near Emmaville, and at Campbell's lode, and as sulphide at each of the preceding places, as well as (in small quantities) at Butler's, the Ottery, and the Folkestone veins. None of the lead veins at the three first-mentioned localities are sufficiently extensive to pay for working for the sake of the lead alone; but as some of the galena contains from 40 oz. to 100 oz. of silver per ton, the veins should be worked to advantage where they attain a width of about 3 feet, provided the veinstone will average not less than 20 oz. of silver per ton.

Copper occurs as carbonate and copper pyrites at Hall's Grampians, Little Plant Creek, Pye's Creek, McDonald's veins on the Glen Creek, and in small quantities in the Ottery vein.

Grey copper ore has been found at the Little Plant Creek and at Pye's Creek, and black oxide at Hall's Grampians.

The principal copper vein seen by me in the district is that known as "Reid's Copper Lode," on Hall's Grampians, in portion 600, parish of Strathbogie North.

The vein, a breccia vein resembling the Little Plant Silver lode, is from 1 to 3 feet wide, and strikes about 16° north of east and south of west, dipping south-easterly. The veinstuff is chiefly chlorite with a little quartz containing blue and green carbonates of copper. The country is a dark thickly cleaved claystone.

In portion 85, parish of Strathbogie North, a vein of cellular quartz about 2 (?) feet wide strikes about 40° east of north and west of south. The veinstuff shows streaks of blue carbonate of copper and a little black oxide. The country is similar to the preceding.

In portion 2, parish of Paradise North, county of Gough, a vein of fluor-spar, and copper carbonate and iron oxide strikes 20° north of east and south of west, dipping northerly. The portion containing the copper carbonate is 4½ inches wide. At the present price of copper none of these veins would pay if worked for copper only. Grey copper ore, containing from 400 oz. to 1,100 oz. of silver per ton, occurs, as already stated, in the silver lodes at the Little Plant Creek, and at Pye's Creek. The argentiferous fahlerz here contains from 30 to 31 per cent. of copper, so that some quantity may be produced from this source, if the silver veins are extensively worked.

Antimony occurs only in combination with copper and lead in the argentiferous fahlerz at the Little Plant and Pye's Creeks.

Zinc has been found in some quantity as blende in the Pye's Creek veins, the Little Plant vein, the copper vein in portion 85, Strathbogie North, at Hall's Grampians, and in small quantities at the M'Intire, Butler's, Ottery's, and the Folkestone veins. The mineral has not yet been found in this district in payable quantity. The value of the ore being only about £7 per ton, and the cost of carriage from the Mole Tableland to the coast being about £5, there is little margin for profit after deducting the expenses of working.

Tungsten.—The ores of this metal, hitherto found in the Vegetable Creek District, are wolfram and scheelite.

Wolfram.—An important vein of wolfram occurs on the Mole Tableland, 13½ miles north of Emmaville in a direct line, but 21 miles distant by road. The point at which the reef was observed to be rich in wolfram, bears west 36° south from the south-west corner of portion 407, parish of Rockvale, county Clive, ¼ of a mile distant, and lies just outside the boundary of this parish, in the north-east corner of the parish of Flagstone, county Gough. The vein is in places from 10 to 12 yards wide, though probably not metalliferous throughout its entire width. Owing to the reef being partly covered over by the iron-stained sandy soil, it is impossible to ascertain by mere inspection the average width or length of its outcrop, though surface indications favour the supposition that the reef is a strong one. The strike is about north 40° east. As far as I am aware this reef has never been prospected, and it is situated partly on Crown Lands. Wolfram also occurs at the Gulf main vein, Hall's Grampians, Lee's Gully, and the Planet vein, near the head of the Nine-mile Creek, parish of Wellington Vale, county Gough.

In 1881 the price of wolfram in England was £10 per ton. In 1882 the total quantity of wolfram raised in Cornwall, England, was 58 tons, which was sold at the rate of £12 17s. 7d. per ton. At the end of March, 1885, the value of wolfram in England, as I am informed by Mr. W. A. Dixon, F.I.C.F.C.S., was about £15 per ton.

The cost of carriage from the wolfram vein on the Mole Tableland to Sydney, *via* Glen Innes, would be between £5 and £6 per ton.

Scheelite has been found in small quantities at M'Donald's veins, on the Glen Creek. The mineral here is honey-coloured and translucent. The price of this mineral in 1885 was about £40 per ton.

Iron occurs in some quantity in the volcanic tuffs, converting them in places into pisolitic ironstone. These deposits are, however, too earthy to be of commercial value. In the veins iron forms a considerable percentage of the gossan forming the cap of veins, being present as a hydrated brown oxide. At about 50 feet from the surface these oxides pass into iron pyrites or asenical pyrites. Iron pyrites occur in some quantity in the Paradise vein east of portion 54, parish of Flagstone, and in small quantity at M'Donald's veins on the Glen Creek, and in the Fergusson tin vein in portion 161, parish of Highland Home, county Gough.

Arsenical pyrites (mispickel) is found in quantity in the Ottery and M'Master's tin veins, in the parish of Tent Hill; at Hall's Grampians, in the veins shown in portions 25 and 27, and W. R. 72, parish of Arvid, county Gough; in Taylor's veins on the Glen Creek; in the Planet and Folkestone veins, near the head of the Nine-mile Creek, Wellington Vale; at Pye's Creek; and in the veins shown on the geological map in portion 15, parish of Silent Grove, county Clive.

Phyrrhotine (magnetic pyrites) has been discovered in small quantities in the Ottery veins.

Magnetite and titaniferous iron are found as small black crystals and rounded grains, intermixed with the stream tin, in the recent and tertiary alluvial beds.

Arsenic is found, combined with iron and sulphur as mispickel, at the localities just mentioned for the occurrence of that mineral. Its association with the tin ores in the other veins renders it necessary to roast the latter ores previous to their reduction in the reverberatory furnaces. The arsenious acid given off during this roasting process is allowed to escape into the air, its value, £9 per ton, not compensating for the labour of saving it.

Manganese occurs in small quantity in the form of black oxide at the tin vein in portion 13, parish of Silent Grove, and in the stream tin gravels of the "deep leads," where it partially encrusts the sand and tin grains, forming lumps of slightly coherent tin "cement."

An impure form of rhodonite occurs at the locality mentioned above at Silent Grove.

Bismuth has been found native and as carbonate and sulphide associated with tin-stone and quartz, in portion 15, parish of Silent Grove. The total width of the vein is about 1 foot, and its strike 15° south of east and north of west, with a northerly dip. The bismuth is distributed through the quartz chiefly in acicular crystals, and lies next to the foot-wall; the thickness of the bismuth bearing part of the vein is 4 inches. Lumps of native bismuth, ¼ of a pound in weight, have been picked up near Burns' Reef, in portion 3, parish of Highland Home, county Gough. Waterworn fragments of the same metal have been found near Taylor's veins, on the Glen Creek; and in one of the veins on Pye's Creek bismuth is reported to have been recently discovered in some quantity. The bismuth vein at Silent Grove and Burns' bismuth vein strike considerably to the south of east and north of west, nearly at right angles to the general course of the tin veins.

Molybdenite has been found only in small quantity at the Yankee tin veins near the Gulf, at Silent Grove, and Taylor's veins on the Glen Creek.

Gold occurs sparingly in minute scales or grains associated with the tin gravel. Analyses of tin tailings from some of the principal shallow alluvial mines on Vegetable Creek, made by Professor A. Liversidge, F.R.S.,* show that traces of gold were found in all the samples assayed, gold being present in one sample from the Little Britain Mine, at the rate of 15 grains per ton. At the Surprise Mines and at Rocky Creek colours of gold are frequently seen. Traces of gold have been found by the Government Analyst in the grey copper ore from the Little Plant Creek.

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* *See* Annual Report of the Department of Mines, New South Wales, for the year 1875.

Gems.—The gems of most common occurrence in this district are sapphires, oriental emeralds, black spinel, chrome spinel, beryl, topaz, zircon, and garnet.

The Sapphires are generally rather small, and most of the specimens waterworn; some show a crystalline shape, being sections of hexagonal pyramids. The colour varies from a pale bronze to various shades of blue and green. A small proportion are transparent, but the majority are dark blue and opaque. Asteria, or sapphires showing a six-rayed star, are occasionally met with. The largest blue sapphire seen by me measured about 1 inch x $\frac{3}{4}$ inch x $\frac{1}{2}$ inch, and sold in the rough for £4; the stone seemed tolerably free from flaws, and was transparent. The purchaser informed me that if the stone cut as well as he hoped he would get two gems, which, when cut and polished, would be worth about £60 each. Green sapphire (oriental emerald) is of less frequent occurrence; the predominant shade of colour is a yellowish green, these gems being more often transparent than the blue sapphires. Blue and green shades of colour may often be observed in the same specimen. Sapphires occur in nearly all the tertiary gravels, especially at the Graveyard Creek and at Kangaroo Flat. Adamantine spar (brown sapphire) occasionally occurs under conditions similar to the sapphire, and has a pale bronzy lustre.

Beryl occurs most frequently in small waterworn round or oval prisms from $\frac{1}{2}$ to $1\frac{1}{2}$ inch long and from $\frac{1}{8}$ to $\frac{1}{4}$ inch thick. The localities where it is most abundant are Surface Hill and Kangaroo Flat. The majority of specimens are pale green, and many are colourless. The gems generally contain a number of minute cavities, which of course detract immensely from their value. Some specimens from Kangaroo Flat, which have been cut and polished, are valued at about £4, the cutting and polishing having cost about £3. At the main Gulf tin vein beryl occurs in situ in the vein in the manner already described.

Topaz is very abundant in the alluvials of most of the creeks which drain from the Mole Tableland. It would appear from this that the intrusive tin granite is the original matrix of the gem, though it has not yet been found here in situ. At Scrubby Gully topazes of a pale sky blue colour are to be found in great abundance. White topazes are plentiful at Blather Arm Creek.

Zircons are generally found in small waterworn prisms or round grains, white, straw coloured, and red. They are associated with the tertiary tin-sands, especially at Ruby Hill. Minute zircons constitute the bulk of the "green tin," or "brass filings," as the gem sand of the Graveyard lead is locally termed.

Garnet occurs both in rounded grains and in matrix, and varies in colour from deep ruby to cinnamon. Garnet occurs in matrix in the dioritic dyke at Boiling Down Creek, and at Patterson's reef; in portions 11 and 12, parish of Fraser, county of Gough, garnet occurs massive as garnet rock in an eruptive mass of chlorite or finely crystalline hornblende. Crystals of garnet occur in the vughs in the garnet rock of a reddish brown colour, some taking the form of the rhombic dodecahedron, while others are modified tetragonal prisms like those of idocrase. The lumps of solid garnet rock in this dyke mass are in places ½ foot in diameter, and were at one time mistaken for ruby tin, and the dyke was worked for that ore on this supposition, until the comparatively valueless character of the mineral was ascertained.

Pipeclay.—Extensive beds of greyish white pipeclay are interstratified with the tertiary sand and gravel of the deep leads. The beds are from 10 to 20 feet thick in places, are very free from grit, and occasionally, as at the Graveyard and Rose Valley, are nearly white, approaching china clays. The value of true china clay in Cornwall, England, delivered free on board ship, is about 25s. per ton, and 278,572 tons were produced in 1880. Good plastic clay in England is worth from 7s. to 10s. per ton, free on board. If pottery works are at some future time established in the Vegetable Creek District they will probably be located at the nearest convenient point to the Ashford coal seam. Firebricks are now manufactured in the district by the Glen Smelting Company. The clay used in their manufacture is a decomposed eurite, which occurs close to the works. The machine used in the manufacture of these bricks is made by John Whitehead and Company, Albert Works, Preston, England; and is capable of producing 10,000 bricks per day with the labour of eight men. All the bricks are pressed with a hand press. About 40,000 are manufactured annually for use in the reverberatory furnaces, at a cost of £6 per thousand. The side-lining and furnace bottoms formed of these bricks last about four months; the crown over the fire-box and the "bridge" require to be renewed every five or six weeks. For the above information I am indebted to the manager, Mr. J. Reid.

Limestone.—In the Vegetable Creek District proper there are no beds of palæozic limestone. There are, however, patches of tufaceous limestone of very limited extent in the recent alluvial deposits; and generally where the basalt is decomposed small nodules of carbonate of lime are sprinkled through the subsoil. The patches of calcareous tufa mostly occur near waterfalls in creeks draining off the basalt. For instance, a few chains west of the south-west corner of portion 91, parish of Annandale, county of Clive, are some masses of calcareous tufa several feet in thickness at the foot of a small waterfall. The total weight of carbonate of lime here cannot be less than 80 tons. In the parish of Limestone, county Arrawatta, about 40 miles westerly from Emmaville, is an extensive bed of very crystalline limestone Palæozoic (?) age. The bed is several hundred feet thick, and has been traced in a north and south direction for between 1 and 2 miles.

Coal.—Coal has been discovered near Fraser's Creek Station, Ashford, 30 miles west of Emmaville. The rocks in which the coal occurs are yellowish grey shales, alternating with thin evenly-bedded felspathic quartzites and grey sandstones. Their general dip is westerly at about 60°, subject to considerable variation of direction and angle, owing to the strata having been much disturbed by intrusive granite, which bounds the coal-bearing rocks at about 1 mile west of the station. The existence of a coal seam in the neighbourhood had been suspected for some years past, as loose blocks of coal were frequently found after heavy floods, washed up on the shingle in the bed of the river Severn, opposite the head station. This led to the discovery of a seam of coal about 3 miles higher up the river, at a place since called "Coal Gully." Beds of hard dull black coal, alternating with carbonaceous clay shales crop out in this gully at a point 30 chains above its junction with the river. The seam dips westerly at from 35° to 60°, striking from 10° to 35° east of north and west of south. This strike would make it cross a large deep waterhole in the river, a few chains above the point where the loose blocks were first noticed; so that there can be little doubt that they were originally derived from this seam. The total thickness of clean coal at Coal Gully, so far as can be judged from the very limited section exposed in the banks, is over 30 feet, the greatest thickness of coal without bands being 7 feet.

The clay shales, near the base of the seam, contain numerous fossil plant remains; but the impressions are not sufficiently distinct to furnish trustworthy evidence as to the geological age of the beds.

The surface coal does not burn readily, owing probably to its volatile constituents having been lost through long exposure to the weather; and to the coal itself being partially infiltrated with clayey material derived from the surface rain-wash. I was informed however, by Mr. John Macdonald, the discoverer of the seam, that by sinking on it a few feet he got coal of a quality sufficiently good to use in a blacksmith's forge. The coal comprising the loose blocks found near the head-station, is of a better quality, its superiority being due more perhaps to its having suffered less from exposure, than to any original difference in chemical composition. Hence there are good grounds for assuming that by sinking to a moderate depth, coal of equally good quality may be obtained from the seam at Coal Gully.

An analysis of coal taken from one of the loose blocks in the river bed, made by the Government Analyst, has given the following results:—

Hygroscopic moisture	1·40	
Volatile hydrocarbons, &c....	20·50	
Fixed carbon	71·94	*
Ash	6·16	
Sulphur in coal	0·52	
Specific gravity	1·35	

* Coke—78·10·

This analysis shows the sample to belong to the class of bituminous caking coals, suitable for smelting and steam coal purposes.

Situated as it is, within 8 miles of large limestone beds of excellent quality for lime burning, and near the border of the tin-fields, this coal-seam may in time form a valuable source of fuel for the district, when wood becomes scarcer, and carriage cheaper.

SUGGESTIONS FOR FUTURE WORKING.

The district at present appears to have two great needs.—

1. A cheaper method of prospecting the deep leads than that of sinking shafts.

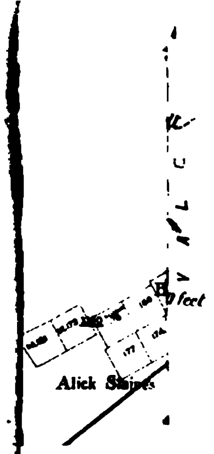
2. A cheaper method of treating the tin tailings and tin sands, at the Y. Water Holes, and near Emmaville, too poor to pay for working on the present principle.

As regards No. 1, a more general employment of rock drills, diamond drills or augers, should prove beneficial, especially in prospecting the wet ground. This method, although not affording reliable evidence as to the tin-bearing character of the drift penetrated, is of value in indicating the position of the deepest ground; and when that has been ascertained, a shaft may be sunk on the site with fair expectations of sucess.

As regards No. 2, by levels taken by aneroid between Emmaville and the Deepwater River at Deepwater, and Emmaville and the Severn River, where the Old Glen Innes to Emmaville road crosses it at Ranger's Valley, a fall is proved to exist towards the flat on which the town stands, of 180 feet in the former case, and of 60 feet in the latter. The former is 16 miles distant from Emmaville, and the latter 14, giving falls respectively of 11 feet, and 4 feet per mile. The amount of fall however, in both cases, would be considerably reduced, especially in the former case, by the necessity of taking the races round by circuitous routes to avoid the hills. Hydraulic sluicing would therefore be impossible; but if the present supply of water could be augmented in the manner suggested, ground sluicing would be greatly facilitated.

During my geological examination of this district, I received every possible assistance and information from miners, and managers of mines, whose properties I visited. I am chiefly indebted to Mr. Alfred Cadell, C.E., for placing at my disposal, his carefully made plans of the underground workings of the Vegetable Creek Tin-mining Company's deep lead, and for a number of his levels, taken with a dumpy level, along the courses of this lead and of the Graveyard lead. To Mr. Hamilton Gordon, of Strathbogie, I owe much for his sketch plans of the basaltic country on the runs of Strathbogie and Rocky Creek, leased by Mr. Hugh Gordon; and also for his valuable personal assistance. My thanks are due to Mr. John Reid, Manager of the Glen Smelting Works, for the unreserved manner in which he answered all my inquiries with reference to the Tent Hill Smelting Works; and also to Mr. Thomas Chandler, J.P., and the late Mr. T. Flannery, for information given in the field, and by letter. Mr. Alfred Ottery helped me much towards understanding the geological structure of the district, by acquainting me with his own observations. Mr. Warden Martin, P.M., kindly placed at my disposal the services of his bailiff, Mr. Stewart; and the Mining Registrar, Mr. W. E. Henry, did all in his power to facilitate my work. I have also to thank the following for their kind assistance:—Mr. R. R. Robertson, lessee of Wellington Vale; Mr. M. Bryant, Manager of Butler's Tin Mining Company; Mr. H. Marshall, Manager for the Torrington Company; Mr. M. W. Carr, late Manager for the Gulf Tin-mining Company; Mr. W. Knucky, Manager for the Great Britain Company, at the Dutchman's Mines; Mr. A. McGillivray, Manager for the same company, at Emmaville; Mr. R. Waters, Manager for the Black Swamp Syndicate; Mr. James Warrell, Manager for Hall Brothers, at Kangaroo Flat; Mr. W. O. Pomeroy, late Manager for the Wesley Company; Mr. A. Osborne, in charge at Silent Grove; and Mr. Purvis, Manager at Maidenhead Station; also to Messrs. T. Reynolds, Colgan, Elliott, D. Bailey, J. Fox, Casley, Curtin, A. Probert, F. G. Taylor, Hamilton, Hopper, Bottrell, Witherden, H. Jew, Griffiths, Bourke, P. Crane, Dodd, Barry and party, L. Webb, R. Davidson, Murgatroyd, Francis, Kelly, Skinner, T. Cubis, and many others.

Sydney: Charles Potter Government Printer.—1887.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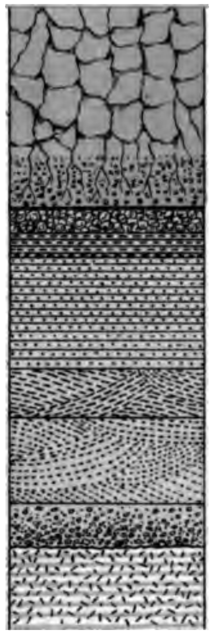

71. 0.	
¼	Band of brown ironstone.
2. 0.	Soft brown and grey basalt.
2. 0.	Very hard grey cemented sandy clay, a compact stone at its junction with the basalt.
8. 0.	Yellow and reddish brown finely bedded, tight, sandy clay, very like decomposed basalt, passing into
4. 0.	Tight, false bedded, yellow sands, becoming looser at bottom of bed.
7. 0.	Loose sand.
3. 6.	Stream tin sands and gravels cemented by clay ironstone so as to form a nearly uniformly compact mass of sandstone grit and conglomerate. Loose patches of clean white sand occur in places, stained black by oxides of manganese.
TOTAL DEPTH OF SHAFT } 144. 2¼.	Chloritic felspar porphyry forming the bed rock, on which the stream tin gravels rest, and containing thin, nearly vertical veins of quartz and tin stone. The channel of the deep lead at this point having been excavated through this metalliferous rock much of the stream tin in the gravels must have been derived from these veins.

Prepared under the Direction of C. S. Wilkinson, F.G.S., F.L.S., Geological Surveyor in Charge, by T. W. E. David B.A., F.G.S., Geological Surveyor, 1883—1884

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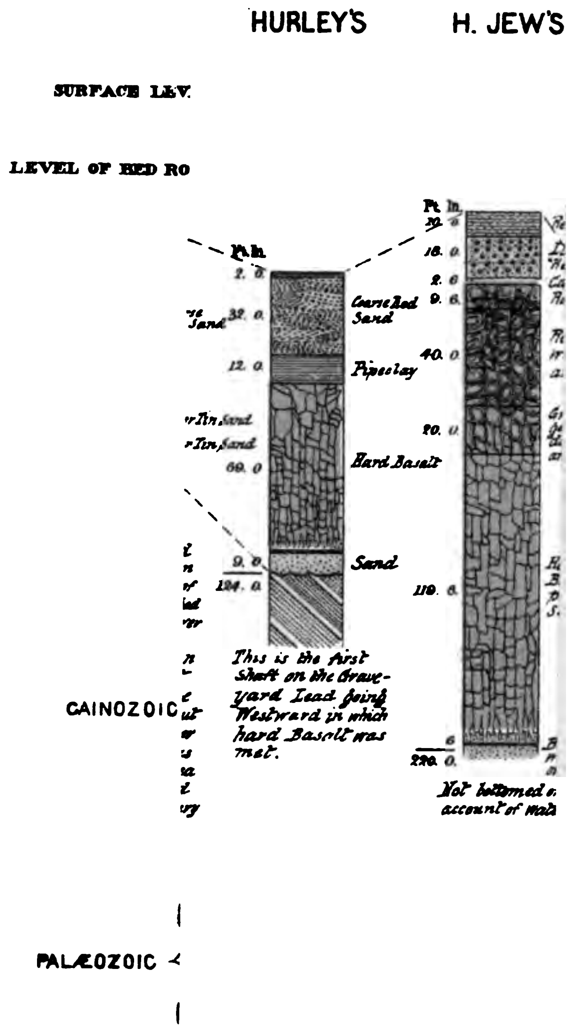

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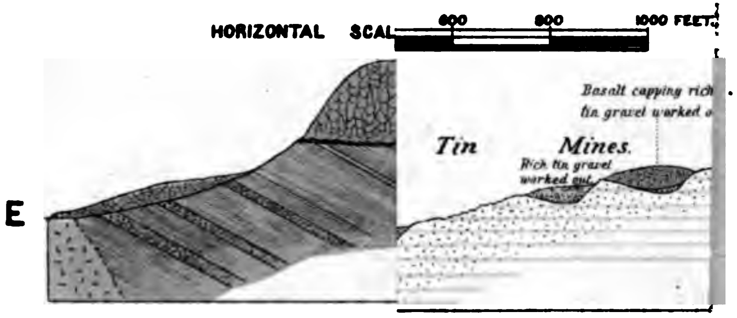
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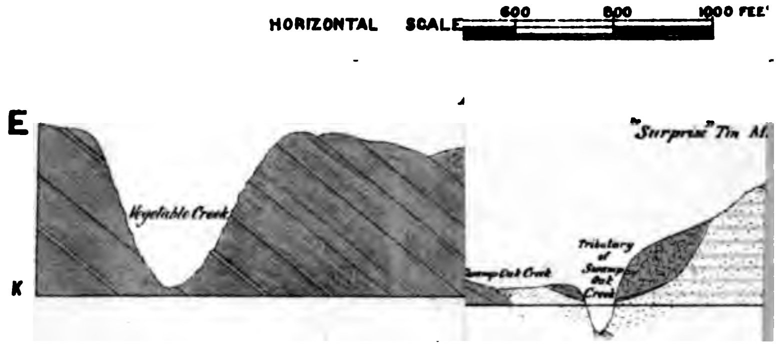

■ *Soft, red basalt and volcanic dust.*

⁙ *Hornblendic granite.*

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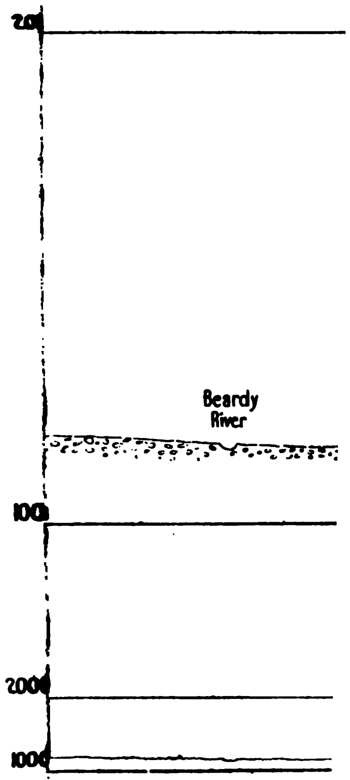

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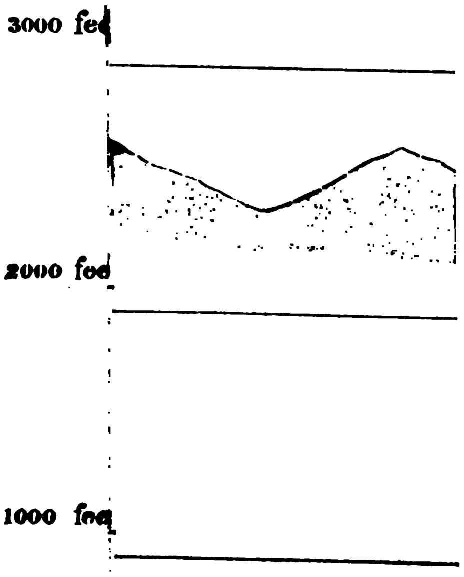

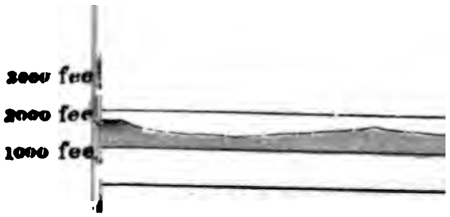

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